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An assessment of joint chat requirements from current usage patterns

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THESIS

AN ASSESSMENT OF JOINT CHAT REQUIREMENTS FROM CURRENT USAGE PATTERNS

by

Bryan A. Eovito

June 2006

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AN ASSESSMENT OF JOINT CHAT REQUIREMENTS FROM CURRENT USAGE PATTERNS

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ABSTRACT

This research assesses the impact of synchronous (real-time), text-based chat on military command and control (C2) processes. Chat use among the services, particularly among joint forces, has evolved in ad hoc fashion to fill gaps in currently fielded C2 systems. This growth-by-improvisation inhibits clear definition of the underlying requirements: precisely what C2 deficiencies are being addressed by text-based chat tools? Or, from a bottom-up perspective: what capabilities do text-based chat tools bring to the war fighter? In this study we employ a broad set of use-cases to further refine why operators use chat based on how they apply chat to their specific combat problems. These use cases include ongoing combat operations in ENDURING FREEDOM, counter-insurgency operations in IRAQI FREEDOM, and disaster relief operations with Joint Task Force - Katrina. The focus of this study is on establishing operators' perceived requirements in light of the current capabilities delivered by the existing text-based chat tools. From these "reverse-engineered" requirements we propose future work to establish these communication capabilities in the next-generation C2 systems.

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I. INTRODUCTION

A. PROBLEM STATEMENT

1. Description

Communication is the essence of command and control (C2), and the availability of real-time, text-based communications tools has led to a proliferation of ad hoc "solutions" for the warfighter. Currently within the services, every command appears to have its own preferred text-based chat client. While these solutions fill short term requirements, they usually miss the mark of joint interoperability. Lack of a standardized text chat tool for C2 has led to confusion and an inability to interoperate. No official text-based chat requirements document exists for any of the services nor is there an official joint chat requirements document. Further, there is no official support for text-based chat from the services' program offices. In effect, within the U.S military there is a tool used extensively for C2 with no official requirements, no official support, and no official sponsorship.

This thesis first assesses the impact of synchronous (real-time), text-based chat on military C2 processes. Operational chat usage is documented across the warfighting functions and the full spectrum of military operations with a brief selection of use cases. The current trend in chat research focuses on the technical aspects of chat based on anecdotal evidence, both of which obscure development of a coherent problem statement. This research consolidates specific cases of chat use to better develop insight into the problem, catalog capability gaps, and generate high-level requirements.

There is risk associated with various chat tools and protocols. These technical risks are well documented by organizations like the Defense Information Systems Agency (DISA). In this paper, we assess not only technical risks, but other risks that are very difficult to quantify, like those related to organization, human factors, doctrine, and perhaps most interestingly, the impact of chat use on other C2 methods.

We finish with a framework for documenting current and developing future high-level chat requirements. These high-level requirements decompose the chat problem to a level that users, engineers, and managers alike can use and understand. From this

common understanding all stakeholders can work together to develop a set of combined and joint, text-based chat requirements for the next-generation C2 systems.

2. Background

Modern chat tools allow multiple, concurrent users real-time participation in multiple chat channels (chat rooms). The conversations within these channels are referred to as threads. The use of client-server architecture provides the ability to scale a population of users from a few locally to thousands globally. Internet Relay Chat (IRC) is one of the most widely used chat protocols for military C2 (Boettcher 2005; Duffy 2005). This study considers chat usage regardless of type, whether chat specific tools like mIRC or Microsoft Chat (MS Chat) or embedded chat functionality found in many C2 systems and collaborative suites like InfoWorkSpace (IWS).

Chat use by the military grew rapidly during Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF). Not only did chat usage grow on its own, we saw chat usage grow to supplement (or in some cases replace) other C2 systems. The experiences of the United State Navy and the United States Central Command (USCENTCOM) illustrate this.

Early during OEF there was one IRC server in the Navy's Fifth Fleet that averaged 300 concurrent chat users (Banerjee 2005). Chat use soon overcame capacity and a second IRC server was installed in Fifth Fleet supporting approximately 500 concurrent users (Banerjee 2005). Chat use grew drastically during OIF and two more IRC servers were installed, bringing the total to four servers supporting approximately 2500-3000 concurrent users in 350-400 chat channels (Banerjee 2005; Heacox, Moore, Morrison, and Yturralde 2004). Figure 1 shows the number of chat users and chat rooms on the Fifth Fleet servers by date from buildup through the start of combat operations.

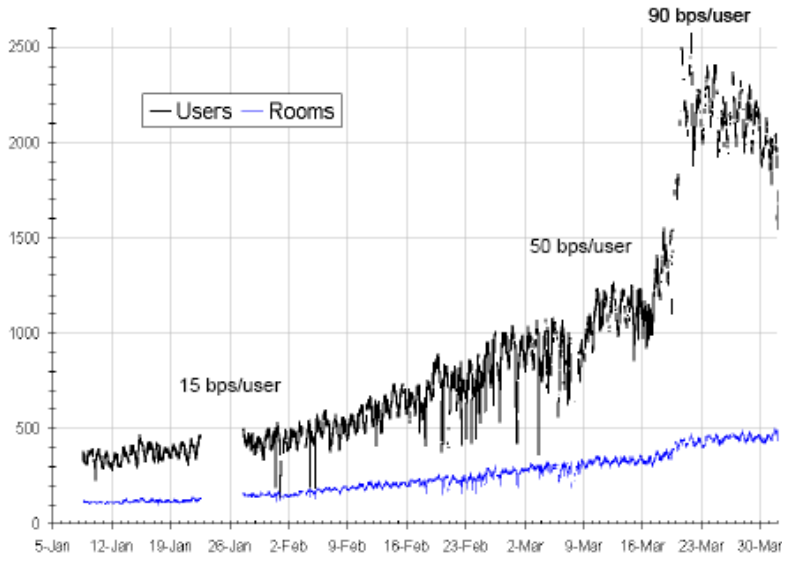

Figure 1. IRC use prior to and during OIF; bps/user = bits per second per user (From: Bentrup, Banerjee, Baldwin, and Kimble 2005)

Prior to OIF, USCENTCOM used the Defense Collaborative Tool Suite (DCTS) chat programs during exercises in Saudi Arabia; however, DCTS provided inadequate chat capability (no multiple room support) and USCENTCOM J6 made the switch to IWS (Jara and Lisowski 2003). The bandwidth requirements of chat with IWS created latency problems and USCENTCOM switched to the US Naval Forces Central Command's (USNAVCENT) four IRC servers in Bahrain, which continue supporting all areas of operations (Banerjee 2005; Jara and Lisowski 2003). Currently servers at USNAVCENT, Al Udeid Airbase in Qatar, Headquarters USCENTCOM, and DISA support the following chat clients: mIRC, MS Chat, JABBER, and Internet Explorer Web Browser clients (Moore 2005).

Users rapidly realized text chat was a mission essential C2 tool and discussion grew about the lack of official requirements, official support, and official sponsorship. Within the Department of the Navy, the Navy's program office, Space and Naval Warfare Command (SPAWAR) reacted first. In response to the Navy's text chat needs, Joint Distributed Command and Control Technologies, SPAWAR Systems Center San Diego (SSC-SD) hosted the 1st Annual Internet Relay Chat Conference in 2004. All four services, numerous Combatant Commands (COCOMs), and Other Government Agencies (OGAs) attended. The conference's purpose was to identify chat users and provide

support to them throughout the Department of Defense (DOD). While focused on IRC protocol-based chat tools, this conference supported users of all chat tools and discussed emerging technologies and the way forward within DOD. The 2nd Annual IRC Conference was held in June 2005 and was again attended by all four services, numerous COCOMs, and OGAs.

During the June 2005 conference, Joint Distributed Command and Control Technologies SSC-SD was tasked with developing the joint chat requirements for a Joint Resource Oversight Council (JROC) package by Joint Chiefs of Staff J-6 (JCS-J6) and Office of the Assistant Secretary of Defense for Networks and Information Integration (ASD (NII)). This research is part of that effort.

3. Research Questions

This thesis addressed four research questions:

a. How is chat used across the services and warfighting functions?

b. Why is chat used across the services and warfighting functions?

c. What risks are associated with chat use?

d. What are the high level chat requirements?

B. OBJECTIVES

The seven objectives developed to answer the research questions were:

1. Document chat use cases across the services, including COCOMs, coalition partners, and OGAs. Use the joint warfighting functions and joint / combined doctrine as the framework guiding collection, analysis, and presentation of the use cases.

2. Document the reasons for warfighter chat use across the same agencies listed in objective one. Collect, analyze, reduce, and report the attributes used by warfighters to communicate why they used chat.

3. Introduce the more difficult to quantify risks associated with the integrity, confidentiality, and availability of chat and the effects of chat use on tactical information exchange and situational awareness.

4. Consolidate the services' explicitly stated chat requirements contained in numerous reports, briefings, emails, capabilities documents, etc.

5. Consolidate selected COCOM explicit chat requirements contained in numerous reports, briefings, emails, capabilities documents, etc.

6. Develop a framework for chat requirements development that decomposes the chat problem to a level that users, engineers, and managers alike can use and understand.

7. Define avenues for future research that support the further development and decomposition of combined and joint, text-based chat requirements for the next-generation C2 systems.

C. SCOPE AND LIMITATIONS

This thesis was limited to the following major tasks: consolidate the available, disparate information; develop the joint chat requirements; and evaluate the TRIDENT WARRIOR (TW05) results. The literature review was limited to documenting the concepts driving military C2 towards real-time collaboration. Requirements development was limited to problem definition and development of a high-level requirements framework for future chat / C2 tool development. This thesis limited the technical review of chat protocols, chat tools, and chat architectures to what supported the research questions and the experimentation.

D. THESIS ORGANIZATION

Chapter II surveys the joint and service concepts driving the evolution of C2, doctrine, and defense acquisition. Chapter III provides the methodology for data collection, analysis, and experimentation. The chat use cases, reasons for chat use, chat risks, and chat requirements are reported in Chapter IV. Chapter V presents opportunities for future research and concludes.

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II. LITERATURE REVIEW

No single body of work defines text-based chat usage for military C2, making a significant, top down literature review necessary. The evolutions in joint force doctrine and current operations drive the changes in military C2 that create capability gaps leading to the surge in chat use. This review starts with the doctrine driving the development of the future joint force and subsequent transformation of the services. Continuing to drill down, we look at the service visions, their transformation roadmaps, and their technology enablers for providing the necessary C2 capabilities to operate as part of the future joint force. Finally, we study the small body of unclassified research focused on military chat use. This work is grouped in three categories: technical, human systems integration (HSI) and a key piece on the risks associated with chat.

A. FUTURE JOINT WARFARE

The DOD's Capabilities-Based Assessment (CBA) process bridges strategic guidance and future joint force capabilities, and the Joint Operations Concepts (JOpsC) family of concepts is the result. The goal is to design, from the ground up, a future joint force that is fully integrated, expeditionary, networked, decentralized, adaptable, lethal, and possesses decision superiority (JCS J7 2006).

The JOpsC is a hierarchy of living documents based upon both future vision and lessons learned from current operations. They are the doctrinal framework for future full-range military operations (JCS J7 2006). Services and other defense agencies develop the Doctrine, Organization, Training, Material, Leadership and Education, Personnel and Facilities (DOTMLPF) solutions to achieve the capabilities enumerated in the JOpsC. Service and joint experimentation evaluate these capabilities and their ability to support decisive operations across the full military spectrum. Figure 2 depicts the JOpsC hierarchy.

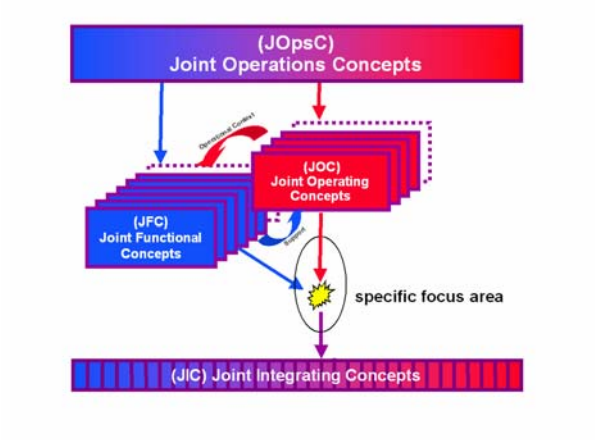

Figure 2. Joint Operations Concepts (JOpsC) Hierarchy (From: CJCS 2004)

The JOpsC play a central role in the Joint Capabilities Integration & Development System (JCIDS) and support the Chairman of the Joint Chiefs of Staff (CJCS) and the JROC in assessing and prioritizing joint military capability needs (CJCS 2005). The JOpsC guide the functional capability analyses that are captured in the capability documents required for Milestone Decisions in defense acquisition projects. This process is captured in Figure 3 ("Family of Joint Future Concepts" refers to the JOpsC).

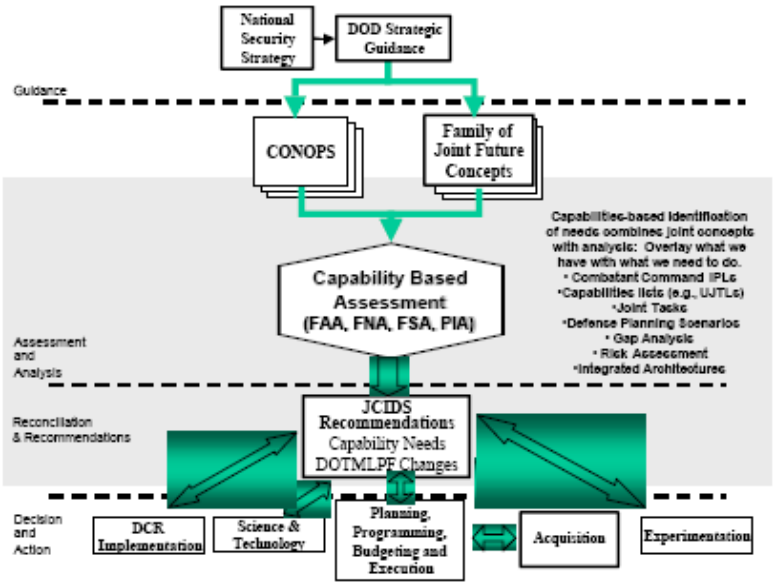

Figure 3. Top down Capability Need Identification Process (From: CJCS 2005)

1. The Capstone Concept for Joint Operations

The Capstone Concept for Joint Operations (CCJO) (2005) is the DOD's capstone concept for future joint warfare. The CCJO provides the broad outline of how the future joint force will operate and the subordinate Joint Operational Concepts (JOCs) and the services' concepts expand upon the CCJO guidance. The CCJO (2005) calls for joint forces to interoperate and share, collaborate, coordinate maneuver, and integrate situational awareness. These concepts seek to create a knowledge-empowered force that makes better, faster decisions at all levels and increases joint force effectiveness (CCJO 2005).

The concepts the CCJO sets forth require significant evolution in joint C2. Of particular note, the CCJO (2005) defines lethality as "the ability to leverage technology to destroy the adversary and/or his systems at range or in close combat." This sets the stage for interim capability gaps in current C2 systems that are being plugged with text chat.

2. Joint Operating Concepts

The four JOCs address the environments, the challenges, and the evolution in DOTMLPF required for the future joint force to operate across the full spectrum of military operations. The JOCs are summarized in Table 1.

Table 1. Joint Operating Concepts Summary

Joint Operating Concept	Summary
Major Combat Operations	Establishes the framework for transitioning the armed forces from the industrial age to the technology age with emphasis on conducting large-scale military actions in a distributed, collaborative environment.
Homeland Defense and Civil Support	How DOD intends to perform its responsibilities associated with securing the Homeland, to include Homeland Defense (HLD), Civil Support (CS), and Emergency Preparedness (EP) in the 2015 timeframe.
Strategic Deterrence	How Joint Force Commanders will plan, prepare, deploy, employ, and sustain a joint force to contribute to a strategic deterrence strategy set forth by national leadership through 2015.
Stability Operations: Military Support to Security, Transition & Reconstruction	"The joint force, as part of a multinational and integrated, multi-agency operation, will provide security, initial humanitarian assistance, limited governance, restoration of essential public services, and other reconstruction assistance."

Sources: (Major Combat Operations Joint Operating Concept 2004; Homeland Defense and Civil Support Joint Operating Concept 2005; Strategic Deterrence Joint Operating Concept 2004; Stability Operations: Military Support to Security, Transition, and Reconstruction Joint Operating Concept 2004)

Each JOC lists robust future C2 requirements; however, these requirements are needed by today's commanders. A brief examination of these requirements helps explain the origin of capability gaps in today's military C2 systems.

The Major Combat Operations Joint Operating Concept (MCO JOC) (2004) declares the rapid advance and proliferation of "information age" technologies require fundamental changes in how we approach warfare and conflict resolution. For achieving this central theme the MCO JOC (2004) states:

> Decisive conclusions are enabled by the fluid and coherent application of joint military action in conjunction with interagency and coalition power, using an effects-based approach and leveraging pervasive knowledge in a networked environment to increase levels of collaboration, precision, unity of purpose and coherency in action.

The Homeland Defense and Civil Support Operating Concept (HLD CS JOC) has eight enabling capabilities. Four of these capabilities listed in the HLD CS JOC (2005) are supported by chat:

- Ensure a collaborative and interoperable DOD and interagency partner unity of effort against threats to the Homeland, to include consequence management operations
- Develop and maintain situational awareness and shared understanding throughout the HLD/CS/EP environments
- Develop and maintain a robust, redundant, secure, decentralized, distributed, collaborative, and interoperable command, control, communications, computers, and intelligence (C4I) system and process
- Develop and maintain robust interagency coordination to include communications interoperability, intelligence sharing, and policies/procedures on entrance and exit strategies for DOD involvement

The Strategic Deterrence Joint Operating Concept (SD JOC) (2004) defines two key capabilities: global situational awareness and robust global C2. Global situational awareness involves gathering intelligence required for deterrence operations. This requires persistent intelligence, surveillance, and reconnaissance (ISR) efforts in a

collaborative environment. Global C2 calls for a horizontally and vertically integrated distributed network to provide key leadership with an effective and survivable command and control capability (SD JOC 2004). This C2 capability must gracefully degrade to a small, but absolutely reliable channel.

The Stability Operations: Military Support to Security, Transition & Reconstruction Joint Operating Concept (SO JOC) is particularly relevant to OEF and OIF. This JOC lists numerous C2 and battlespace awareness capabilities required for success. Table 2 summarizes those capabilities required in OEF and OIF that drive chat use.

Table 2. SO JOC Capabilities Driving Chat Use in OEF and OIF

Command and Control	**Battlespace Awareness**
-- The ability to conduct collaborative, planning, execution, and information sharing among US civil-military agencies and coalition partners from the operational to tactical levels. -- The ability to achieve multi-agency coherency of action during planning, coordination, and execution by creating a joint, and combined when necessary, multi-agency planning and execution organization empowered to facilitate integrated civil-military operations. -- The ability to enhance rapid information sharing with coalition members, multi-agency players, and non-governmental organizations through information sharing technologies and policies. -- The ability to field a command and control system with reach back capability and connectivity to facilitate other agency participation.	-- The ability to achieve a persistent situational awareness and shared understanding in a joint, multi-agency, and multinational context in order to know the operational environment and the interrelationship among ourselves, our adversaries, and the local population. -- The ability to use an operational net assessment to support stability operations and to reflect that information in the integrated civil-military common relevant operating picture. -- The ability to provide persistent intelligence, surveillance and reconnaissance that integrates all intelligence capabilities, including human intelligence assets, into the overall intelligence, surveillance, and reconnaissance architecture.

Source: (Stability Operations: Military Support to Security, Transition, and Reconstruction Joint Operating Concept 2004)

These JOCs list numerous C2 and battlespace awareness capabilities required for the future joint forces to conduct operations across the full military spectrum. They rely heavily upon joint force connectivity throughout the battlespace to facilitate vertical and

horizontal collaboration during all operational phases across the spectrum of military operations. The current Global War on Terrorism (GWOT) is the type of complex conflict envisioned for the future joint force. With the current joint force already fighting the "future" conflict, we can see gaps empirically in current C2 systems that have our warfighters looking for ad hoc solutions like text chat.

3. Joint Functional Concepts

The Joint Functional Concepts (JFC) broadly addresses their respective functional areas across the range of military operations. The three impacting C2 are: Net-Centric Environment (NC JFC), Command and Control (C2 JFC), and Battlespace Awareness (BA JFC). These three have direct impact on contemporary C2 issues and are driving future C2 development. The NC JFC, C2 JFC, and BA JFC are summarized in Table 3.

Table 3. Select Joint Functional Capability Summary

Joint Functional Concept	Summary
Net-Centric Environment	*"The Net-Centric Environment is a framework for full human and technical connectivity and interoperability that allows all DOD users and mission partners to share the information they need, when they need it, in a form they can understand and act on with confidence, and protects information from those who should not have it."*
Command and Control	*"In 2015 Joint C2 will be a joint decision-making process that is dynamic, decentralized, distributed, deployable, and highly adaptive. Enabled by a robust, secure, integrated network, and through the employment of collaborative information environments, the Joint Force Commander will possess a seamless, deployable command and control capability."*
Battlespace Awareness	*"Battlespace Awareness in 2015 provides actionable intelligence to commanders and warfighters. This capability, enabled by a thorough understanding of the battlespace focusing on the adversary and other relevant factors, brings to bear a responsive system-of-systems fully integrating personnel, documents, equipment, and technical means in providing persistent, redundant, and tailored coverage."*

Sources: (Net-Centric Environment Joint Functional Concept 2005; Joint Command and Control Functional Concept 2004; Functional Concept for Battlespace Awareness 2003)

4. Joint Integrating Concepts

The Joint Integrating Concepts (JICs) address specific military problems within the broad functional areas of the JFCs. The two impacting C2 are: Command and Control (C2 JIC) and Net-Centric Operating Environment (NC JIC). These JICs address the required tasks and standards within the functional areas. This lends them to

identification, assessment, and analysis of capability gaps and solutions. The C2 JIC and NC JIC are summarized in Table 4.

Table 4. Select Joint Integrating Concept Summary

Joint Integrating Concept	Summary
Command and Control	*"This Joint Integrating Concept (JIC) promotes the development of C2 capabilities for agile, decisive, and integrated force employment in all phases of combat and supporting operations, as required by the National Military Strategy."*
Net-Centric Environment	*"The concept's central idea is that, for the future Joint Force to achieve decisive levels of shared knowledge and technical connectivity, the NCOE must provide the Joint Force with pervasive knowledge through the full integration of knowledge management(KM), network management (NM), and information assurance (IA)."*

Sources: (Command and Control Joint Integrating Concept 2005; Net-Centric Operational Environment Joint Integrating Concept 2005)

B. SERVICE VISIONS AND TRANSFORMATION

The service visions, transformation plans, and technology enablers focus, like the JOpsC, on leveraging technology to destroy the adversary. They are listed by service in Table 5 and then discussed by service in the following sections.

Table 5. Vision, Transformation, and Technology Doctrine by Service

Service	Vision	Transformation	Technology
US Army	FM:1 The Army	Army Transformation Roadmap	LANDWARNET
US Air Force	America's Air Force Vision 2020	U.S. Air Force Transformation Flight Plan 2004	Command and Control (C2) Constellation
US Navy	Sea Power 21	Naval Transformation Roadmap 2003	FORCEnet: A Functional Concept for the 21st Century
US Marine Corps	Strategy 21	Marine Capstone Concepts	Marine Air Ground Task Force Command and Control

1. United States Army

a. Field Manual 1: The Army

Field Manual (FM) 1: The Army (2005) establishes the principles for land power employment that drive Army doctrine and looks at Army contributions to the future joint force. This vision also sets forth Mission Command as the Army's preferred

C2 method. Mission Command implementation is supported by two components of the Army Vision: integrating component technology of future combat systems and developing networked information systems. The integration component includes sensors, information systems, and manned and unmanned vehicles to improve commanders' situational awareness (SA). The networked component is a family of networked land and airborne maneuver and supporting systems built around the soldier.

b. Army Transformation Roadmap

The 2004 Army Transformation Roadmap (2004) explains how the Army will maintain current capabilities while developing new capabilities required for the future joint force. The Army intends its Future Combat Systems (FCS) to achieve the integration of component technology of future combat systems and development of networked information systems called for in FM1. Finally, the Army's roadmap sets forth LandWarNet for tying together its FCS equipped forces and integrating them into the Global Information Grid (GIG).

c. LANDWARNET

The Army LandWarNet literature consists primarily of a collection of presentations, reports, and briefs. The Army Chief Information Officer (CIO)/G-6 and the Army Training and Doctrine Command (TRADOC) are developing the LANDWARNET concept with Network Enterprise Technology Command (NETCOM)/9th Army Signal Command (Public Affairs Guidance (PAG) on Army Focus Area, The Network 2005). LandWarNet is the Army Enterprise Network, its portion of the GIG, providing networks to the Active Component forces, National Guard, Army Reserve, and sustaining bases (LANDWARNET: Network Strategy for Land Combat 2004). Three interrelated, integrated, and interactive domains comprise LANDWARNET: communications, computing infrastructure, and core enterprise services (Public Affairs Guidance (PAG) on Army Focus Area, The Network 2005).

2. United States Air Force

a. America's Air Force Vision 2020

America's Air Force Vision 2020 (2000) envisions a future aerospace force whose contributions to the future joint force are based on its technological and operational developments that increase its combat capability. The C2 challenges of this

future aerospace force stem from the required global integration of distributed space, airborne, and land components with information operations (IO).

b. U.S. Air Force Transformation Flight Plan 2004 (Flight Plan)

Flight Plan (2004) is how the Air Force is transforming and developing its military capabilities, with emphasis on joint and coalition warfighting enablers, as part of the future joint force. Appendix D details Flight Plan support to the required JOpsC capabilities. Flight Plan focuses on a methodology for Air Force transformation rather than specifics. There is emphasis on the role of science and technology development to address six long term challenges including global integration of air and space C2.

c. Command and Control (C2) Constellation

The Concept of Operations (CONOPS) for Command and Control (C2) Constellation version 8 (2003) draws on the objectives and desired effects of the Space and C4ISR CONOPS established in the Flight Plan to quickly deliver information to the warfighter. The CONOPS for C2 Constellation (2003) will provide:

> "…standard network services and a shared Combat Information Environment to C2 centers and Joint and coalition combat and combat support aircraft to enable the flow of decision-quality information and support warfighter collaboration by creating an intuitive decision environment through full access to battlespace information. Current discrete air, ground, and space networks will be adapted and interconnected to form a seamless information dissemination grid."

Battlefield Management Command and Control (BMC2) is the heart of the C2 Constellation that will eliminate the current stovepipe systems and integrate the required elements to achieve the desired Air Force capabilities outlined in America's Air Force Vision 2020.

3. United States Navy

a. Naval Power 21

Naval Power 21 (2002), signed by both the Chief of Naval Operations (CNO) and the Commandant of the Marine Corps (CMC), presents a vision based on three pillars: we assure access, we fight and win, and we are continually transforming to improve. This document provides the foundation for the Navy's Sea Power 21 and

Marine Corps' Strategy 21 visions and concepts for achieving their required service capabilities and their required capabilities as part of the future joint force.

b. Sea Power 21

Sea Power 21 (2002) defines the three interdependent Navy Capability Pillars (NCP): Sea Basing, Sea Strike, Sea Shield, and their network-centric enabler, FORCEnet. These concepts create the current and future capabilities that will ensure the Navy's ability to fulfill its portion of Naval Power 21. These concepts rely on information management (IM) and knowledge management (KM) to compress and increase the lethality of the C2 process. The required information superiority is provided by networked sensors, platforms, and systems, persistent ISR, and IO.

c. Naval Transformation Roadmap 2003

The Naval Transformation Roadmap 2003 (2003), signed by both the CNO and CMC, states that every aspect of naval transformation is driven by joint principles to develop the NCPs required by the future joint force. This document maps the naval capability pillars against the JOpsC, illustrating their applicability. The roadmap explains how current and future Navy and Marine Corps capabilities must integrate to provide robust, joint C2 to land, airborne, sub-surface, surface, and space forces operating globally.

d. FORCEnet: A Functional Concept for the 21st Century

FORCEnet: A Functional Concept for the 21st Century (2005), signed by the CNO and CMC, defines FORCEnet as "the operational construct and architectural framework for naval warfare in the Information Age, integrating warriors, sensors, command and control, platforms, and weapons into a networked, distributed combat force." FORCEnet provides the network-centric capabilities enabling the NCP concepts. FORCEnet allows the Navy-Marine Corps Team to generate the capabilities called for in Naval Power 21 and the JOpsC, and readies naval forces for their role in the future joint force.

4. United States Marine Corps

a. Strategy 21

Strategy 21 (2000) provides the broad visions, goals, and aims to develop future USMC combat capabilities and contributions to Naval Power 21. Expeditionary

Maneuver Warfare (EMW) is the centerpiece of the Marine Corps vision. Strategy 21 (2000) states, "Marine Corps Strategy 21 guides a Marine Corps capable of accomplishing its specified and implied tasks derived from the guidance in the National Security Strategy, the National Military Strategy, and other strategic documents." Originally developed to meet the Joint Vision 2020 (JV2020) guidance on the evolution of the armed forces, Strategy 21 speaks in terms of capabilities and remains relevant in creating Marine Corps capabilities to support the JOpsC as part of the future joint force (Capstone Concepts 2005).

b. Marine Capstone Concepts

U.S. Marine Corps Concepts and Programs 2005 (2005) sets forth EMW as the capstone concept guiding how the USMC will organize, deploy, employ, and sustain current and future forces. Incorporated into EMW are the concepts Operational Maneuver from the Sea (OMFTS), Ship to Objective Maneuver (STOM), Sustained Operations Ashore (SOA), and Other Expeditionary Operations (OEO). Additional concepts are Distributed Operations (DO) and Information Operations. These concepts drive the need for a robust, integrated, and networked C2 capability. They require sustained, over the horizon operation by units of various sizes throughout the battlespace and may in fact shape the battlespace, as demonstrated by the GWOT.

c. Marine Air Ground Task Force Command and Control

The Marine Air Ground Task Force Command and Control (MAGTF C2) program exists primarily as a collection of briefs outlining the concept. The presentation MAGTF C2 Strategy (2005) describes MAGTF C2 as: "… end to end, fully integrated, cross functional set of MAGTF C2 capabilities that include forward deployed as well as reach back." Essentially, MAGTF C2 envisions a system of systems to achieve integration and interoperability. Dukes (2005), in his MAGTF C2 Brief to the ISR Operational Advisory Group (OAG), states C2 must be joint and mapped the MAGTF C2 layers to the FORCEnet capabilities.

C. MILITARY CHAT RESEARCH

1. Center for Naval Analyses

The Center for Naval Analyses (CNA) researched chat performance in the fleet during OEF, OIF, and various experiments. This research was conducted for the Office

of the Chief of Naval Operations (OPNAV) N61 and Commander of Naval Network Warfare Command (NETWARCOM). The findings are reported in the following four documents. While the researcher reviewed classified CNA reports, only unclassified CNA work is discussed here.

a. Proposed NETWARCOM Guidance: The Effective Use of Chat

Banerjee and Bentrup (2002) document how the introduction of chat outpaced the fleet's understanding of how best to use and manage it. The authors develop an analytical framework for a Navy IM plan to aid NETWARCOM in providing clear guidance to the fleet regarding chat use (Banerjee and Bentrup 2002).

b. Fleet Chat Requirements

In this white paper Banerjee and Bentrup (2003) wrote that an at-sea environment places unique requirements on collaborative tools, outlined the fleet chat requirements, and compared a number of different tools against those requirements. They reported that while DCTS met the requirements of shore-based users, it fell short of meeting the at-sea requirements they outlined.

d. Distributed Internet Relay Chat Architecture

Bentrup, Banerjee, and Baldwin (2005) discuss distributed IRC architectures, one of the recommendations from in the CNA report Fleet Chat Requirements. The distributed IRC architecture was compared to the Navy's traditional hub-and-spoke architecture. The findings are summarized in Table 6.

Table 6. Summary of Findings From Distributed Relay Chat Architecture (After: Bentrup, Banerjee, and Baldwin 2005)

1. A distributed chat architecture is superior to the current hub-and-spoke architecture
2. Greater savings can be achieved by compressing the server-to-server links
3. A distributed chat architecture is compatible with the current hub-and-spoke architecture.
4. The fleet needs to use a single version of IRC server software.
5. The fleet needs to recognize the value of open source products.

c. Trident Warrior 04: Distributed Internet Relay Chat Architecture for Afloat Networks

Bentrup, Banerjee, and Baldwin (2005a) analyze the distributed IRC architecture used during the Navy's TW04. Areas studied included: chat reliability,

server-to-server connectivity and reconnect, bandwidth efficiency and costs, chat availability, and affect on SA. Table 7 summarizes the operational results from the experiment.

Table 7. TRIDENT WARRIOR 04 Distributed Chat Architecture Operational Results Summary

1. Shipboard server allowed users aboard USS TARAWA to chat intra-ship during communications outages
2. Situational Awareness improved: chat history, reduced down time, faster reconnects, and improved situational awareness on reconnect
3. Chat uptime (availability) improved by 27% and average duration connection improved by a factor of 5

2. Pacific Science & Engineering Group

The Pacific Science & Engineering Group (PACSCI) research focuses on the HSI aspects of Navy chat use and its evolution.

a. Survey of Chat Usage in the Fleet: Results

Moore and Heacox (2005) documented the evolution of chat use during OEF and OIF. Surveys from 183 OIF chat users captured chat usage patterns and some perceived warfighter requirements. The survey was hosted online using one of Commander, Carrier Group One's (CCG-1) servers. The survey results are reported by the categories taken from the sample demographics.

Moore and Heacox (2005) discovered that 79 percent of respondents participated in one to four chat rooms and that 23 percent participated in 5 or more. While participating in these chat rooms, 65 percent of respondents monitored one to four additional chat rooms and 23 percent monitored an additional five or more (Moore and Heacox 2005). Figure 4 shows what four of the respondent groups used chat for.

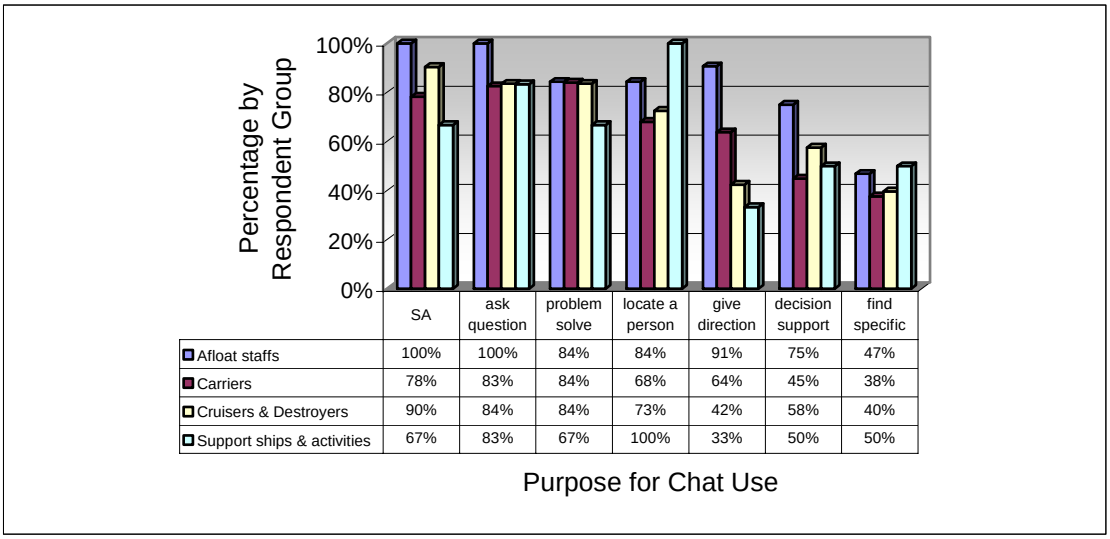

Figure 4. Purpose for chat use (as percentage) by respondent group (After: Heacox and Moore 2005)

b. Usability of Chat in the Maritime Coalition Environment: Empirical Findings from a Limited Objective Experiment for Trident Warrior 2005

Catanzaro, Gwynne, and Mitchell (2005) report their findings from a LOE where novice and experienced chat users performed a series of 24 tasks. Task performance was evaluated for five different chat tools, summarized within this report, with an individual report for each chat tool (listed in the bibliography). Catanzaro, Gwynne, and Mitchell (2005) concluded that chat HSI features should be implemented in terms of the operational requirements for chat in a maritime coalition environment, that there are numerous interface design features that affect the chat tools' ability to meet these requirements, and that a prioritized list of chat features can be used to develop interface design guidelines for naval chat.

3. Massachusetts Institute of Technology

In Cummings (2004), Need for Command and Control Instant Message Adaptive Interfaces: Lessons Learned from Tactical Tomahawk Human-in-the-Loop Simulations, researchers uncovered some interesting data concerning chat use. Results indicated that some operators focused on the chat tool rather than their primary task of missile control, which lead to degradation of performance and SA.

This is some of the first research documenting some of the issues arising from the proliferation of chat use. The results of the report are not unexpected and are in fact often discussed within the military, but only generally and anecdotally.

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III. METHODOLOGY

A. RESEARCH

The very nature of chat's unofficial status made the study of existing research difficult. Most chat-related documents consist of briefs and presentations, unpublished internal reports, and email discussions. Significant and continued effort was spent soliciting, collecting, and consolidating these materials into the required knowledge base. Once accomplished, information gaps were identified with three key gaps becoming immediately apparent:

- most information addressed chat indirectly and at the service level or major command level
- information collected from "lower levels" provided no documentation of what "lower levels" actually referred to, nor was the summarized or raw input available
- no one was in charge of chat, at best a person involved in collaboration had some involvement, more commonly it was a civilian employee that "unofficially" addressed chat

Based upon these key information gaps, this thesis focused its research effort at the tactical level. Example units are: Army Brigade (Brigade Combat Teams) and below, Marine Regiment (Regimental Combat Teams) and below, Air Force Squadron and below, Navy Expeditionary or Carrier Strike Groups down to the single ship. While focused on the tactical, research was also conducted to verify stated chat use and requirements at the operational and the strategic levels.

1. DIRECT OBSERVATION

The researcher's personal experience as a US Marine Corps Command and Control Systems Officer (Military Occupational Specialty 0602) provided an applied chat knowledge base. This knowledge base includes the planning, installation, operation, and maintenance of various chat tools with infantry, artillery, special operations forces, and embarked amphibious units. Experience gained using chat as a watch officer demonstrated the difficulties in successfully integrating chat with warfighting doctrine.

The researcher also participated in the Navy's annual Sea Trial Experiment, TW05. This allowed the researcher to observe and participate in planning, chat tool development, chat limited objective experiments, and document first hand joint and coalition chat use at sea during a major joint and combined exercise scenario with a US Navy Expeditionary Strike Group.

2. SURVEYS AND INTERVIEWS

a. Selecting Participants

The survey and interview process targeted military officers at the tactical level, pay grades O-3 and O-4. This group represents typical unit commanders, staff officers, and watch officers across the services. Appendix B provides the full survey demographics of respondents. Table 8 summarizes the pay grades of respondents by service from Appendix B.

Table 8. Pay grades of respondents by service

Organization	O5	O4	O3	O2	Total
US Marine Corps	0	10	16	2	28
US Air Force	0	6	8	1	15
US Navy	1	2	4	0	7
US Army	0	2	1	0	3
Canadian Forces	0	0	1	0	1
Royal New Zealand Navy	0	1	1	0	2
Royal Australian Navy	0	1	0	0	1
Total	1	22	31	3	58

Table 9 summarizes the operational tours of respondents by operation From Appendix B.

Table 9. Number of tours of survey respondents by operation

Operation	Tours
ENDURING FREEDOM	23
ENDURING FREEDOM-PHILIPPINES	1
IRAQI FREEDOM – I	26
IRAQI FREEDOM – II	9
SUBSEQUENT IRAQI FREEDOM ROTATION	2
SOUTHERN WATCH	7
UPHOLD DEMOCRACY	1
ALLIED FORCE	1
PROVIDE COMFORT	1
SECURE TOMRROW	1
JTF-Katrina	2
ALTAIR (CANADIAN OEF PARALLEL)	1
UNISON (CANADIAN KATRINA RELIEF)	1

b. Administering Surveys and Interviews

The surveys and interviews were administered with the same device from Appendix C to ensure continuity of results between the two forms of data collection. Rather than use a web-based survey, the survey was emailed to participants to introduce a response bias, limiting respondents to those that had actually used chat and were willing to take the time to complete the survey, save it, and email it back. This resulted in extremely high quality responses that were easily incorporated into the research. Despite this built-in bias, there were still numerous responses that were simply not useful or the respondent never used chat.

3. AAR/LL

UNCLASSIFIED, CONFIDENTIAL, and SECRET after action reports and lessons learned were reviewed. In an effort to reach the broadest possible domestic and foreign audience, only the UNCLASSIFIED are reported on specifically in this thesis. An in-depth review of the classified reports and lessons learned found no substantive differences from the UNCLASSIFIED ones; they simply contained non-releasable specifics and details. Table 10 provides the number of action reports and lessons learned reviewed by organization.

Table 10. Number of After Action Reports/Lessons Learned by organization

Organization	Number
US Army	18
US Navy	570
US Air Force	70
US Marine Corps	107
US Coast Guard	220
Combatant Command	17

B. DISCUSSION

Much of this thesis research was qualitative. Surveys, supplemented with extensive personal communication were used to uncover user expectations and common requirements in collaboration tools.

C. ANALYSIS

The unstructured nature of the text-based chat requirements and lack of clear problem definition required an artful, systems architecting approach. The two architecting methodologies primarily used were the Participative (stakeholder-based) and the Heuristic (lessons learned) and are considered the "art" part of systems engineering (Maier and Rechtin 2002). The ad hoc nature that led us to this point in chat use dictates that a participative, stakeholder approach is critical. The fact that the chat "problem" (however undefined) is only now being addressed, after years of actual operational use, means there exists some historical record of use that we may apply heuristics to draw insight. However, scientific methodologies like the normative (solution-based) or the rational (methods-based) were also used.

The participative methodology recognizes numerous, conflicted stakeholders exist and makes its objective consensus (Maier and Rechtin 2002). This plays to chat's wide use, its varied users, and the proliferation of tools. The heuristic methodology is a "common sense" approach based on collective wisdom simply and concisely stated (Maier and Rechtin 2002).

Systems engineers/architects and project managers may only work on a few major projects in their lifetime, resulting in a focused experience within a certain field. Heuristics serve as an abstraction for experience, allowing people to draw on past

experience from other fields and functions to address problems within their own (Maier and Rechtin 2002).

This thesis focused on warfighter involvement and chat lessons learned to clearly state the problem, document experience, and develop a framework that allows future researchers to scientifically approach text-based chat. In parallel, this thesis also participated in major scientific experimentation regarding text-based chat to aid in the research and to act as a check and balance.

D. EXPERIMENTATION

1. TRIDENT WARRIOR Objectives

"Define Navy FORCEnet DOTMLPF requirements for a maritime chat tool" was a stated objective of TW05, NETWARCOM's annual FORCEnet Sea Trial exercise (TW05 Analysis Report 2006). Table 11 lists the IM chat initiative objectives.

Table 11. TRIDENT WARRIOR Information Management chat-related objectives

Objective 2	**Universal Chat Client (UCC)** - Assess the capability of UCC to fill the documented gaps that currently exist in current maritime chat protocols used throughout the US Navy.
Objective 3	**Über Chat** – Does Über Chat provide functionality that fills identified gaps in current maritime chat protocols?
Objective 4	**Extensible Messaging and Presence Protocol (XMPP)** - Does XMPP provide functionality that fills identified gaps in current maritime chat tools?
Objective 5	**Multi-Level Chat (ML Chat)** - Does ML Chat's unique functionality of chatting across two or more domains provide the functionality necessary for Navy Maritime Chat?
Objective 6	**Persistent War Room (PWR)** - Will PWR and Chat Logging operate over lower bandwidth subnets and provide the operator ready access to chat functions and supporting information as well as archived chat logs?
Objective 8	**Distributed Chat Architecture (DCA)** – Compare the proposed DCA (hub and leaf) to the current (hub & spoke) IRC communications architecture. Provide a technical solution to operator concerns including loss of situational awareness, reconnection to servers after a communications outage, intra-ship text chat communications when off-ship communications are down.

Source: TW05 Analysis Report

The experiment was conducted at sea while executing a week-long tactical scenario that included US naval and coalition ships, embarked 24th Marine Expeditionary Unit Special Operations Capable (MEU (SOC)) staff, shore-based units, and numerous manned and unmanned aircraft. Different data network conditions were implemented to

evaluate the objectives under communications conditions from ideal to severely degraded.

The thesis researcher worked with NETWARCOM's TW05 IM Lead during all stages from planning through execution. This provided the opportunity to participate with one of the services on defining their chat requirements as part of a major joint and coalition experiment with the USS IWO JIMA ESG, the 24th MEU (SOC), and the AUSCANNZUKUS coalition.

In preparation for TW05, the researcher participated in a risk reduction LOE conducted at SSC-SD. The LOE had two parts. In first part researchers from the CNA tested the distributed chat architectures planned for use during TW05 and simulated the various network conditions planned.

The second part consisted of HSI studies conducted by PACSCI on the chat tools that were going to be used during TW05. This was crucial to the spiral development approach used for some of the chat tools. They were developed with previously collected and developed chat tool requirements. The LOE allowed the PACSCI scientists to observe users operating the chat tools and develop a refined requirements list. These refined requirements allowed the NETWARCOM IM Lead and the chat tool developers to re-design the chat tools in preparation for TW05.

2. TRIDENT WARRIOR Background

TRIDENT WARRIOR operates under the supporting concept of Sea Trial that supports the Naval Capability Pillars. Sea Trial: Commander U.S. Fleet Forces Command Instruction (COMFLTFORCOMINST) 3900.1 (2003) establishes responsibilities and prescribes general procedures for Sea Trial implementation and states the Marine Corps, as part of the naval force, is an equal partner at all levels of Sea Trial, with the Commanding General (CG), Marine Corps Combat Development Commanded (MCCDC) the Marine Corps Sea Trial coordinator.

The Sea Trial Executive Steering Group (STESG) members defined by Sea Trial include major Navy and Marine Corps commands and agencies. The instruction designates Commander Naval Network Warfare Command (COMNAVNETWARCOM)

as the Sea Trial Operational Agent for FORCEnet. Naval Postgraduate School is tasked with concept development and research in support of the NCPs and FORCEnet.

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IV. FINDINGS

This chapter has four sections: chat use cases, an analysis of why chat is used, an examination of chat's risks, and a requirements framework.

A. USE CASES

The warfighter has expanded the role of chat across the full spectrum of military operations. Commanders and innovative operators at all levels and units have grown their own chat solutions to complex C2 problems despite the many systems fielded to solve the same. Chat is used by the warfighter to put steel on target, or conversely, to build schools and repair mosques. These operational examples are intentionally broad to provide a brief yet substantive illustration of the far-reaching use of chat for military C2. Table 12 lists these use cases by functional area.

Table 12. Use cases by functional area

J-3 Operations	J-2 Intelligence
Multinational Operations	Counterintelligence
Disaster Relief Operations/Civil Military Operations	National Intelligence Support to Joint Operations
Antiterrorism/Homeland Defense	
Special Operations	
UAV Operations	
Targeting	
Close Air Support	
Combat Recovery	
Medical Evacuation	
Meteorological and Oceanographic Support to Joint Operations	

1. J-3 Operations

a. Multinational Operations

Her Majesty's Canadian Ship (HMCS) TORONTO (FFH-333) participated in OPERATION ALTAIR (Canadian OEF parallel) in 2004. She deployed as a fully integrated escort of the USS GEORGE WASHINGTON'S (CVN-73) Carrier Strike Group (CSG) to the Arabian Gulf.

The CSG exercised C2 with chat over SIPRNET (Secure Internet Protocol Routed Network), which HMCS TORONTO (the CSG's only foreign ship) could not access. Canadian Forces task by voice; however, the CSG used the coalition wide area network (COWAN) chat for tasking HMCS TORONTO, with voice circuits as backup. United Kingdom and New Zealand vessels in the area of operations (AO) were also on COWAN chat.

TORONTO stood picket duty in sector screen for the CSG, tasked and coordinated over COWAN chat. Tasking orders for urgent maritime interdiction operations (MIO) were sent to HMCS TORONTO over the COWAN chat and she boarded 123 ships for the CSG.

The Combat Officer, HMCS TORONTO summed up chat issues from the Canadian point of view. The U.S. Navy did not rely on a single chat tool for C2. With HMCS TORONTO as the only non-U.S. warship it was easy for the CSG to overlook the need to use COWAN chat. Even with a liaison officer (LNO) aboard the George Washington and six months together, the U.S. never made the leap to using COWAN and continued using primarily SIPRNET chat. The recommendation was that coalition forces should use coalition networks.

b. Disaster Relief Operations/Civil Military Operations

Amphibious Squadron Four (PHIBRON4), embarked aboard the USS IWO JIMA (LHD-7), used chat for C2 during humanitarian operations with Joint Task Force-Katrina (JTF-Katrina). Chat was used extensively to plan, task, and coordinate pre-deployment and underway. Upon arrival in New Orleans, the movement of amphibious craft for transporting personnel, equipment, and supplies ashore was coordinated and tracked through chat. Situation Reports (SITREPs) from the ships and detachments ashore were sent to PHIBRON4 with chat and then sent from PHIBRON4 to Amphibious Group 2 (PHIBGRU2) by the same means. After Hurricane Rita, the USS TORTUGA (LSD-46), in Cameron, Louisiana, passed information on its amphibious craft operations and SITREPs over chat to PHIBRON4, still embarked on the USS IWO JIMA in New Orleans.

Canada executed Operation UNISON in response to Hurricane Katrina, sending its East Coast Task Group, including HMCS TORONTO (FFH-333), to Biloxi, Mississippi during September and October of 2005. Operations were reported to the USS Saipan using Maritime Command Operational Information Network (MCOIN) chat (MCOIN facilitates Canadian maritime C2 with U.S. Navy). The Canadian Task Group requested and coordinated landing support for its engineers, wood, generators, and other supplies over MCOIN chat.

United States Marine Forces Atlantic (USMARFORLANT) recognized a gap in its C2 capability during JTF-Katrina operations. The USMARFORLANT lessons learned from JTF-Katrina included one entitled "Real Time Information Dissemination." Watch Officers had difficulty disseminating timely information with email. Citing successful chat usage in OIF for the conduct of fire [fire support] and unmanned aerial vehicle (UAV) operations, it was recommended that USMARFORLANT establish chat rooms to support real time information dissemination (Gray 2005).

The Area of Responsibility (AOR) for the U.S. Southern Command (USSOUTHCOM) is a huge geographic area where disaster relief efforts are not uncommon and civil military operations (CMOs) are the norm. Headquarters USSOUTHCOM uses the chat capabilities of DCTS to coordinate and support CMOs in its AOR. Chat was used to coordinate disaster relief efforts for the flooding in Guatemala caused by Hurricane Stan in 2005.

c. Antiterrorism/Homeland Defense

An antiterrorism vignette from Commander Coast Guard District 14 message 162008Z MAY 03, After Action Report: Terrorism Threat on Board Cruise Ship Legend of the Seas (LOS), 22-24 April 03:

> On 22 April 2003 Royal Caribbean Cruise lines cruise ship Legend of the Sea (LOS) was en route from Ensenada, Mexico to Hilo, Hawaii for a scheduled port call with 1668 passengers and 701 crewmembers. A cleaner found a written note in a restroom threatening the lives of American passengers onboard. LOS reported the note to Royal Caribbean Cruise Lines who informed the National Response Center (NRC) and the

> Federal Bureau of Investigation (FBI). Captain of the Port, Honolulu, ordered LOS to not enter port and divert to anchorage offshore. A 123 member multi-agency boarding was conducted to secure and clear LOS (D14 2003).

Coast Guard District 14 (D14) assumed Lead Federal Agency (LFA) for the boarding and operated in two SIPRNET chat rooms that included USCG Pacific Area, US Pacific Command (USPACOM), Commander U.S. Pacific Fleet, and 93rd Weapons of Mass Destruction Civil Support Team (93rd WMD-SCT).

A Marine Corps Visit, Board, Search and Seizure (VBSS) vignette from the 2003-2004 deployment of the 13th MEU (SOC) in the Arabian Gulf:

> The Maritime Special Purpose Force (MSPF) Commander is aboard the shouldering ship with laptop and chat connectivity. The Force Platoon Commander is on the boarded vessel. They were in contact over voice radio, but the MSPF Commander was in contact with the Landing Force Operations Center [LFOC] aboard a US Navy amphibious ship using chat. Prowords for mission segments, information requests, and the unfolding mission were passed and tracked in chat. The LFOC passed additional tasking to the MSPF as the mission progressed. The VBSS resulted in the seizure of hashish with an estimated value in the millions.

d. Special Operations

In 2002 and 2003, during OEF in Afghanistan, units from Third Special Forces Group (Airborne) operated widely dispersed as part of the Combined Special Operations Task Force (CJSOTF). Third Group was equipped with AN/PSC-5 Satellite Radios, but assigned a single voice satellite communications (SATCOM) channel shared by the entire CJSOTF within the theater and reserved for command, emergencies, or units in contact. The SATCOM radios were data capable with ruggedized laptops allowing Special Forces teams to send free text messages. This is significant, because despite not having an actual chat tool, units used the free text messaging capability to provide an improvised chat (more specifically instant messaging) functionality to fill the C2 gap. Army Special Forces firebases always had SATCOM connectivity with the text

messaging capability running and most business within the firebases was conducted by text conversations. While on the move during operations, teams were contacted over voice SATCOM and told to come up on the laptops for text messaging.

One Special Forces Operational Detachment A (ODA) Commander recounted how this text-based communications capability aided operations. His ODA team was operating in an area where another unit's mission fell through. His team received a voice call over SATCOM to come up on SATCOM data. With the text messaging capability he received a fragmentary order (FRAGO), acknowledged receipt, and discussed operational details. This improvised chat capability allowed the ODA team to execute the FRAGO much more rapidly than if a voice exchange had taken place. The ODA executed a cordon and search of a small village, resulting in two personnel under control (PUCs – enemy combatants; not prisoners of war) and capture of a weapons cache. The SITREP was sent to higher headquarters using the improvised chat capability, which would read it and start asking questions back.

In another case, after mission completion, an ODA team sent a SITREP to higher headquarters using the improvised chat. The CJSOTF replied immediately concerning the PUCs the ODA had in custody. The ODA Commander replied, telling the CJSOTF when and where the Afghan Militia Forces (AMF) captured the PUCs, passed their descriptions, what PUC1 and PUC2 said when debriefed, and that they had dual identification that did not check out. He also reported that they had weapons and were seen leaving a large cache with rifle propelled grenades (RPGs), Soviet style mines, detonation cord, etc. Information continued to be passed and then the CJSOTF directed the ODA team to maintain positive control of the PUCs and document all information about them. The total, detailed exchange required only a couple of minutes with the improvised chat.

e. UAV Operations

Sixth Marine Regiment used chat for global collaboration during Direct Support (DS) UAV operations. Sixth Marines, in Afghanistan for OEF, used chat to communicate with the Air Force UAV pilot and payload operator at Nellis Air Force Base (AFB), Nevada. During the UAV mission, the regiment requested specific actions

by the pilot and the payload operator in real time, while the Army Collection Manager for the CJTF monitored the chat room and tracked the mission.

Second Battalion, Fifth Marines (2/5) used chat for UAV operations in OIF I and OIF II. Chat allowed 2/5 to direct the pilot and the payload operator during the mission and disseminate what the UAV was seeing.

Marine Unmanned Aerial Vehicle Squadron Two (VMU-2) used chat extensively during OIF II and OIF III. Chat was used for UAV support to targeting, strike execution, and close air support (CAS) for units supported by VMU-2 UAVs.

f. Targeting

Third Infantry Division (3ID) OIF targeting vignette:

> Baghdad...watched a BM-21 moved to outskirts of city S/SE; fires 3-5 rounds, returns to city. 3ID following on UAV (in DS to DIV) and tracks launcher back into the city where launcher links with re-supply vehicle. 96D SGT HOLT, Paul is watching on GBS [Global Broadcast System] monitor and is in mIRC Chat talking to Air Force FAC [Forward Air Controller] while the Targeting Officer, 1LT Elizabeth Snyder is talking to CFACC [Combined Force Air Component Commander] in parallel. SGT Holt verifies grid and confirms target. Air force destroys target. Total time of sensing to shooter - 20 minutes...would have been earlier but he [BM-21] was driving in residential area...ACE did not see the re-supply vehicle in the field he drove into until the BM-21 stopped at its hide site (CALL 2003).

The US Air Force's 421st Fighter Squadron used SIPRNET-based chat for time sensitive targeting. This allowed collaboration with the Combined Air Operations Center (CAOC) at Al Udeid Airbase for questions on targets, the ATO, or strike-related questions and coordination with parallel agencies. Dynamic targeting and strikes were also facilitated by chat. For example, a ground unit calls in a troops in contact (TIC) report, the information flows to squadron operations, which can then re-task aircraft to collect targeting intelligence or to execute CAS. This applied to situations beyond troops in contact like pipeline attacks or suspicious activity where jets from the 421st would be re-tasked to a specific target for surveillance. The squadron monitored the mission and watched the CAOC direct events. Monitoring the mission in chat aided in debrief preparation and expedited the debrief/mission report process once the pilots returned.

g. Close Air Support

During OIF the 4th Air Support Operations Group (4th ASOG) attached to the US Army V Corps used chat continuously for CAS execution among US Army V Corps, Coalition Land Forces Component Command (CFLCC), Combined Force Air Component Commander (CFACC), and Marine Expeditionary Forces (MEF). They provided C2 for all V Corps CAS missions and considered chat absolutely critical to mission accomplishment because it was the most expedient method of communication and allowed real-time collaboration.

Chat was used by 4th ASOG to task UAVs (Predator, Hunter, Shadow, Global Hawk) and other assets to collect and disseminate intelligence to Tactical Air Control Parties (TACP), CAS aircraft, V Corps ACE (Analysis and Control Element), and any other units requiring the information for CAS execution. Chat was further used for de-confliction of CAS, joint fire support, and of CAS and UAV airspace, real-time, within V Corps, MEF, CFACC, UAV units, and Air Force Distributed Ground Stations (AF DGS) – the people exploiting UAV imagery.

The 22d MEU (SOC) in Afghanistan for OEF coordinated details of emergency CAS tasking over chat, mainly for the requesting, allocating, and tasking stages. The senior watch officer would post TIC reports in the main chat room and CAS details would be worked out in the same room or in private chat with liaison officers at CJTF-76 ACCE. Changes to CAS were discussed in chat before and during the mission. Changes would be sent to coordinating agencies in chat and from there radioed to airborne aircraft. The Marine Direct Air Support Center (DASC) used chat to update what aircraft would execute CAS and their status (i.e. tanking, time remaining on station).

h. Combat Recovery

The 421st Fighter Squadron used chat extensively in every combat search and rescue (CSAR) mission during OIF. Chat was the primary tool used with UHF/VHF voice circuits for airspace de-confliction and for supporting arms and close air support (CAS) coordination during combat recovery missions. The 24th MEU (SOC) used chat during OIF I and OIF II to request aircraft for combat recovery missions and to pass information.

Helicopter Anti-Submarine Squadron 3 (HS-3 "TRIDENTS") embarked aboard the USS ENTERPRISE (CVN-65) for OEF, used chat for joint CSAR. The TRIDENTS supported joint maritime CSAR and CSAR for western Pakistan and southern Afghanistan.

Chat was also used for search and rescue missions (SAR) in the United States. Again, HS-3 used chat, this time to coordinate a joint Navy and Coast Guard maritime rescue off of North Carolina.

i. Medical Evacuation

Chat played a significant role in the medical evacuation (MEDEVAC) process around the world and across the spectrum of military operations. Chat was used in Afghanistan during OEF by CJTF-180 to coordinate MEDEVACS of combat and non-combat casualties. The CJTF also used chat to clear fires in the MEDEVAC airspace. The 22nd MEU (SOC) also used chat for MEDEVACS as part of CJTF-180 and later CJTF-76 in Afghanistan during OEF. Units posted MEDEVAC 9-lines (standardized request format) to the main chat room and the MEU would either task their organic air assets with the MEDEVAC over chat or use chat to request support from higher headquarters. When Third Battalion, Sixth Marines (3/6) received a unit in contact report they immediately monitored the MEDEVAC preparations in the aviation brigade's chat room and passed MEDEVAC information to the CJTF in chat.

During two deployments to Iraq, Helicopter Marine Heavy Squadron-465 (HMH-465) received tasking from higher to execute MEDEVACs. The 9-line (MEDEVAC) information was passed to the squadron over chat and then handed to the MEDEVAC pilot just prior to launch. This information included grid coordinates, radio frequencies, what to expect at the landing zone (LZ), etc.

Chat was also used to coordinate MEDEVACs during Disaster Relief Operations. The USS IWO JIMA used chat to coordinate MEDEVACs as part of JTF-Katrina

j. Meteorological and Oceanographic Support to Joint Operations

Meteorological and oceanographic (METOC) forecasting support affects joint and combined operations across the full military spectrum. Chat has proven a vital

tool for coordinating weather forecasts for various theaters. Southern Command METOC (J332) personnel used chat during Operation SECURE TOMORROW to coordinate weather support for Royal Canadian Air Force helicopters flying in-and-around Port-au-Prince, Haiti.

The 28th Operational Weather Squadron (OWS) at Shaw Air Force Base (AFB), South Carolina used chat to support OEF/OIF. With chat they conducted forecast coordination, tailoring, and dissemination to in-theater units from one platform.

The lack of weather data in Iraq complicated forecasting efforts, but with chat METOC units at the CAOC, Al Udeid Airbase, Qatar and others spread throughout Iraq could collaborate with each other and with the regional forecasting center at Shaw AFB. The collaboration enabled by chat allowed them to develop one general forecast for the entire theater.

US Central Air Forces Command (USCENTAF) METOC used chat to provide weather support to all four services in both the OEF and OIF theaters. Chat was used to communicate with units in the field and discuss weather products. These units in the field were able to act as "eyes forward" feeding weather information back to USCENTAF that was integral to their product construction. They found chat use provided a more constant and reliable flow of information than other available methods (i.e. phone, email). With chat they were able to provide the best-tailored weather products to units because chat provided access to most units, enabling efficient, multi-person discussions that affected large groups of people. The time-sensitivity of some weather products was met with chat, which proved the fastest and most reliable method for their dissemination.

2. J-2 Intelligence

a. Counterintelligence

Members of the Air Force Office of Special Investigations (AFOSI) Detachment 105, Robins AFB, Georgia provide real time counterintelligence support in the Metro-Atlanta and middle Georgia AOR. They used chat for real-time discussion about intelligence and force protection information with the Clayton County Sheriff's Office, Georgia Intelligence Sharing Analysis Center (GISAC) and other local law

enforcement agencies. Chat allowed AFOSI personnel to set up target areas to work sources and liaison with any nearby Air Force interests. Chat is used for planning and execution because of its ease of use.

b. National Intelligence Support to Joint Operations

The US Air Force's 55th Wing provided national intelligence support to OEF and OIF with their RC-135 Rivet Joint (intelligence, surveillance, reconnaissance platform) aircraft. Chat was vital for real time re-tasking, target sharing, and indications and warning for ground elements. More efficient than voice, chat allowed real-time connectivity with everybody at once, including joint and combined forces in theater and reach back to various stateside agencies. The most common use of chat was for coordination between on-station RC-135 Rivet Joints, the CAOC, and strike aircraft and similar coordination with ground elements

B. USE ASSESSMENT

There are many reasons warfighters choose to use chat. When answering the question of "why chat?" numerous attributes were given. Many of these attributes were synonymous, while some grouped well into subsets of others. For productive discussion we wanted to refine the reasons given for chat use into common language, so we combine and reduce them to the top five reasons for use.

1. Faster

Faster applies the chat users' ability to request, send, and receive large amounts of information in real-time. This is particularly useful for tasking. Tasks sent in chat are immediately available for the recipient unit to read once you send it. Various members of the unit tasked can immediately read it and begin task clarification and refinement within their respective functional areas using chat. Subordinate and supporting units can also monitor these taskings and begin coordination and parallel planning, compressing the planning process and ultimately the time to prepare for mission execution. Tasking within chat happens so fast that some feel the chain of command is bypassed because very often, when higher headquarters tasks the intermediate headquarters, the tactical units already see the tasking and begin working. However; many units leverage this speed to generate operational tempo, particularly in the dynamic counterinsurgent and

disaster relief environments. Users report that chat aids in speeding up commanders' OODA Loops (Observe, Orient, Decide, Act).

Units are re-tasked fast with chat. The use cases demonstrated this: CAS aircraft in the air, UAVs, Special Forces teams – these, and others, can all be dynamically tasked during the mission because of the speed generated with chat.

Faster also applies to the transmission time and turn around times of other systems. There is no need to draft a radio message, hand it to the Radio Watch Supervisor, and wait for the operator to send it. Chat does not need to be read line by line like a radio message and copied down at the other end. You do not have to retransmit sections of the message or read back sections to ensure understanding like you do with radio. Even if two actuals (commanders or staff officers) are talking to each other they (or somebody) need to take notes as grids, times, target numbers and the like are passed. This is unnecessary with chat, generating speed and making it faster.

Finding a phone number, dialing it, waiting for an answer, and then waiting for the person you actually want to talk too to get on the line can be long process. They may not be there requiring you to work with somebody else or even leave a message. If they are there you have to read grids, targets, etc back and forth and copy them down. Again, we see how chat generates speed.

Users point out that even email, file transfer, and web-based forms are too slow. They spend time looking up email addresses and websites. They have to wait on the distant end to read their requests and answer back. This is slower than chat. Now imagine you need to send the information to ten people in ten different units or agencies.

Chat is fast because it generates operational tempo. The increased flow of information across units, functions, operational boundaries, and services increase speed in planning and speed in execution.

2. Easy

Easy does include convenience, but easy helps make chat fast. With chat, users have a list of who is in the room. All users in the room can read the chat thread (unless sent private) so users do not need to look up email addresses, phone numbers, or radio network IDs.

With many users in the room, no multiple radio calls, emails, or phone calls need to be made. Collaboration is the norm in chat, no need to coordinate it like white boarding sessions, conference calls, or video teleconferences. The ability to monitor multiple rooms means that you can monitor multiple missions of various units. Users feel it is easy to build and maintain their situational awareness this way.

Chat uses plain language that is easier to converse in and understand than radio procedure, for example. Chat automatically creates a record of the conversation in the room that you can refer back to for clarification or even review later for after action items. Some chat tools can log their conversations so there is a record beyond what is currently displayed in the room.

Users said that chat was easier than other communication systems like tactical radio networks, or secure telephones (STU-III/STE). Some noted that is easier to type in Mission Oriented Protective Posture (MOPP) gear with a gas mask than talk on a radio or phone.

One must be wary of the convenience factor, because chat may not be the best tool for all situations, but is used anyway. For instance, a request that a user needs filled in hours or days is probably better sent over email than in chat. Inundating chat with non-time sensitive information creates clutter, confusion, and makes chat slower and harder to use.

3. Availability

This attribute is a composite of attributes like connectivity, reliability, stability. Users found (and now expect) chat to be there when other C2 systems are not. Further, they expect the users they want in the room 24 hours a day, 7 days a week.

When users enter a chat room, they not only expect other users within their unit to be available, but "everybody else" worldwide. Users cite chat's ability to provide a collaborative C2 capability between multiple garrison (headquarters) units in the continental US and deployed units worldwide in a single tool. This global capability is the minimum C2 capability expected by many warfighters interviewed. Further, users expect chat to provide this capability over SIPRNET, high side (TOP SECRET

networks), and even on Non-secure Internet Protocol Routed Network (NIPRNET) for coalition disaster relief operations like JTF-Katrina or Operation Unified ASSISTANCE.

Users find that chat is available when other C2 systems are not. They reported that chat was the only form of communications in many cases, where units were too far for voice, and the available transmission systems lacked the bandwidth for larger C2 systems. The geographic dispersion and topography of Afghanistan coupled with its lack of infrastructure is a perfect example. Users at Forward Operating Bases (FOBs) in Afghanistan during OEF reported having only a couple phone lines, which allowed only two concurrent phone conversations, but provided them the ability to dial in with chat and have several concurrent chat sessions.

Even when there is more robust transmission systems support, these systems lack the bandwidth for many workstations with larger C2 systems, so warfighters limit the number of these and use chat to fill this capability gap. Many chat tools use very little bandwidth allowing more users to use chat than other C2 systems; these tools avoid latency and timing hits on the network. When the network experiences issues and capabilities degrade (intentionally or not), text-based chat is the minimum "gotta have" and generally available long after the other C2 systems have stopped functioning.

Users know chat will be available and reliable and work that into their C4 plans. When deployed, the first data system up in many cases is chat. Chat is then used to coordinate bringing up and establishing connectivity with the other C2 systems. Chat is the user's troubleshooting tool of choice, used for the global troubleshooting of SECRET and high side systems in theater, across theaters, and even with contractors stateside.

4. Efficient

Users like how chat allows them to send more data with far less expenditure of time and effort. For example, various reports can be sent in chat while the user continues to look at the Common Operating Picture (COP); map software, or other tools. They can monitor chat while working in these tools.

Stated before, chat's capability for users to access multiple rooms and have conversations with multiple people with no extra effort is a capability strongly embraced by the warfighter. Returning to sending reports, users send reports to large groups of

people with the same effort it takes to send it to one. While reports can certainly be sent by email, chat allows other users who may not doctrinally need the report but are monitoring the chat room to receive it, increasing their SA at no additional cost in time or effort. Chat allows users to be proactive rather than reactive within and across organizations. One should note that this could lead to the dreaded overreact, or proactive action on bad information, and points to the need for good business rules. Some, organizations, like USCENTAF, have already developed chat business rules.

Users like how chat facilitates understanding with written text. Time and effort is saved from repeating questions because you have it written before you – if information is missing users can identify it faster. This persistence is not provided as efficiently with other C2 means that use paper logs or even digital methods like email where users waste time rifling through email chains.

Chat allows a division of labor between units throughout the world. Preparation of the forecasts by the METOC in the use cases is a perfect example. Deployed units drawing upon other units globally can experience economies of scale.

Technically, the operation of chat should breed efficiency. We already mentioned bandwidth and latency, but with chat there is no retransmission of radio traffic or stepping on each, no repeated phone calls back and forth. This creates efficiency elsewhere; reduced radio traffic freeing voice nets for urgent tactical traffic, phones free for when needed, less load on email servers.

5. Required

This attribute is interesting and foreshadows some of the issues in the next section on chat risks. If most business is done in chat, then you need chat to do business. Users feel that without chat, their SA would be diminished and information dissemination and coordination would be a struggle. In cases where chat did become unavailable, users did find themselves behind the power curve trying to use other methods (particularly voice) because their business practices had actually changed (note that the business rules did not change with the practices).

Requirement goes beyond capability when you consider combined operations. The HMCS Toronto's experience demonstrated that chat is required during coalition

operations, but not everybody is always on the same chat. The Canadian ship's call for a single chat was echoed by Expeditionary Strike Group Six (ESG-6). The ESG noted that forces under tactical control of coalition forces should use a collation chat solution (in this case CENTRIX) where you would normally use SIPRNET-based chat (ESG-6 2005). The counterintelligence use case demonstrated how a military unit was required to use chat with civil authorities to prosecute their force protection mission.

The attribute "required" goes back to the problem statement of this paper. There are numerous chat tools in use that do not interoperate. There are major issues during combined operations. If we believe, as users claim, chat is a required tool for warfighting, we need representation and program support to facilitate standardization and interoperability.

C. CHAT RISKS

Chat, like all military C2 systems, has associated internal and external risks that must be mitigated to an acceptable level. The factors creating risk are technical, organizational, and related to HSI. These risks affect the baseline Information Assurance (IA) requirements of confidentiality, availability, and integrity set forth in DOD Directive 8500.1: IA (2002) and DOD Instruction 8500.2: IA Implementation (2003).

1. External Risks

The external risks are those to critical infrastructure and parallel to the generalized threats to the GIG and other national (coalition partners) networks (JCS and DISA 2005). The peer to peer aspect (P2P) of chat includes risk, and was banned initially before being authorized conditional to adherence with the appropriate IA practices and Designated Approving Authority (DAA) approval (Wells 2004a and Wells 2004b). This does not mean the risks were mitigated, but only accepted.

2. Internal Risks

a. Integrity

Internal risks are the greatest, with 75 – 80 percent of all network attacks and loss of proprietary or classified information attributed to internal, authorized users (JCS and DISA 2005). Research has shown chat use can lead to a group phenomenon termed *false sense of security*, where things happen to quickly in virtual collaboration and lead to premature decisions (Wainfan, Lynne and Davis 2004). This impacts the integrity

of information in chat. The MEF Tactical Air Control Center (TACC) experienced information integrity issues within chat rooms during OIF ranging from erroneous grid coordinates, transposed numbers for times, and even an incorrect order to execute a Tactical Recovery of Aircraft and Personnel mission (TRAP) (Glasgow 2003).

b. Confidentiality

With most chat residing on the SIPRNET, confidentiality is less at risk by external disclosure than by disclosure to or lack of disclosure from internal users. Many user IDs used in chat are functional, making it difficult to know who is really in the chat room. Some consider that human nature creates risk, with users lying about their identity, sharing accounts, failing to log out, account compromise, and somebody looking over your shoulder or even "sniffing" your conversation (JCS and DISA 2005). Malicious software may be received and activated by users if coming from a "person" they are comfortable with in chat (JCS and DISA 2005).

c. Availability

Availability is impacted by several factors, with bandwidth the major factor affecting units' ability to use chat, particularly the chat capabilities of larger collaboration suites. During Operation UNIFIED ASSISTANCE, initial use of IWS chat by deployed METOC teams failed due to insufficient bandwidth, forcing all units supporting the Joint Operations Area Forecast (JOAF) to be switched to a smaller, less bandwidth intensive chat tool (Hey 2005; Symes 2005). A similar instance happened to CJTF-Haiti METOC personnel from USSOUTHCOM using the DCTS chat software, which failed due to bandwidth and latency shortfalls (Kampmeyer 2004). The Stryker Combat Teams of 3rd Brigade, 2ID used chat in Iraq to great effect; however, they too, suffered bandwidth-related availability issues (3rd Brigade, 2ID 2004).

3. Tactical Information Exchange and Situational Awareness

Finally, chat can actually affect the units' tactical operations and situational awareness. The Combined Anti-Armor Teams (CAAT) of Weapons Company, Third Battalion, Fourth Marines struggled to receive important information in Iraq. Important tactical information, TICs, be on the lookout (BOLO) reports, friendly troop movements, and more was sent in chat, not tactical radio networks leaving those units without chat out of the loop (Butler 2005a; 2005b). Recent research into human performance issues for

supervisory control of the Navy's new Tactical Tomahawk missile, reported by Cummings (2005) made the unexpected discovery that many subjects fixated on the chat interface and ignored the task of retargeting missiles in urgent situations. The experiment subjects were repeatedly instructed that retargeting was their primary mission; however, they continued to fixate on chat answering all queries before the retargeting problems (Cummings 2005). The Command, Control, Communications, Computers, and Combat Systems Officer (C5O) of the USS IWO JIMA, while standing watch noted that the volume of chat traffic inundated users with information. This information deluge consisted of legitimate traffic and spurious requests from users requesting information in the names of higher headquarters units. When the C5O started calling these users based off their profile information, he discovered they were lower ranking personnel collecting information for briefs and reports. In most cases the information had already been passed and chat was being used because it proved easier to ask for the information directly than look it up.

Significant research opportunity exists looking into managing the risk of chat use. Technical solutions abound, but standardization and the ability to integrate cross-domain within our own forces, let alone with coalition partners, remain problems of policy and organizational behavior. Organizational change must be coupled with HSI research to ensure success. Only by addressing risk as a dependency of technical, organizational, and HSI issues will we reach an acceptable level of risk for the DAA.

D. REQUIREMENTS

This thesis developed a framework for categorizing and developing future chat requirements. The framework consists of four categories: Functionality, Information Assurance, Scalability, and Interoperability.

These categories were derived through study and discourse on the compiled, explicitly stated service and select COCOM and OGA text-based chat requirements. This was guided by the concepts set forth and capabilities called for in the joint and service warfighting concepts previously discussed. Appendix D compares the compiled, explicitly stated text-based chat requirements by service. Appendix E compares the compiled, explicitly stated text-based chat requirements by COCOM and OGA.

The focus of effort to develop the framework for considering chat requirements was on the definition of C2 capability gaps filled by chat and the identification of capability needs. This top down, systems engineering approach focused on chat lessons learned and stakeholders' required capabilities to broadly define common requirement categories and high-level requirements. This is crucial because while many organizations listed the same gaps and requirements, they had very different ideas of what those requirements meant to them (i.e. a bandwidth austere environment to the Navy is very different from that of the Air Force).

1. Functional

The word function, as it regards to technology, often lacks a commonly understood definition. We define it here as: "the action for which a person or thing is specially fitted or used or for which a thing exists" (Merriam-Webster Online, s.v. "function"). This requirements category addresses those requirements that contribute to the desired core capability (core function); real-time text-based chat.

A key question when considering functional requirements is: "which requirements directly contribute to the core function and which requirements add capability not required for the core function?" For example, the "participate in multiple concurrent chat sessions" requirement materially contributes to the core function. The "hyperlinks" and "file transfer" requirements, while useful, are not required to achieve the core function. This is evident in Appendices D and E by what requirements the organizations do or do not agree on. Eight of eight organizations agree that the ability to participate in multiple concurrent chat sessions is required, suggesting this is a bond fide core requirement. Only one organization lists the "hyperlinks" requirement and only two organizations lists the "file transfer" requirement, suggesting that these are not required to achieve the core function of text-based chat. Table 13 lists the consolidated functional requirements from Appendices D and E.

Table 13. Consolidated functional requirements

Functional Requirements (* denotes a core requirement)
1. Participate in Multiple Concurrent Chat Sessions*
2. Display Each Chat Session as Separate Window
3. Persistent Rooms & Transitory Rooms*
4. Room Access Configurable by Users
5. Automatic Reconnect & Rejoin Rooms*
6. Thread Population/Repopulation*
7. Private Chat "Whisper"*
8. One-to-One IM (P2P)
9. Off-line Messaging
10. User Configured System Alerts
11. Suppress System Event Messages
12. Text Copying*
13. Text Entering*
14. Text Display*
15. Text Retention in Workspace*
16. Hyperlinks
17. Foreign Language Text Translation
18. File Transfer
19. Portal Capable
20. Web Client
21. Presence Awareness/Active Directory*
22. Naming Conventions Identify Functional Position*
23. Multiple Naming Conventions
24. Multiple User Types
25. Distribution Group Mgmt System for Users
26. Date/Time Stamp*
27. Chat Logging*
28. User Access to Chat Logs*
30. Interrupt Sessions

Recall the use assessment section in this chapter. Under easy, we noted that easy includes convenience. The non-core requirements listed by stakeholders represent conveniences. Just as inundating chat with non-time sensitive information makes chat slower and harder to use, so does including non-core requirements. These non-core requirements impact other reasons warfighters use chat, that it is: faster, available, and efficient. This does not mean these non-core requirements are not valid, but they must be addressed carefully as they may adversely impact the reasons chat works for C2. The high-level scalability requirements, as defined by this research, demonstrate how many of these functional issues may be addressed.

2. Information Assurance

Information assurance requirements seek to provide the capability to ensure the integrity, the confidentiality, and the availability of the chat tool. These requirements must account for, manage, and mitigate the risks associated with chat use. This includes the risks discussed in this thesis applied to various network types: secure (SIPRNET), non-secure (NIPRNET), coalition, and ad-hoc (i.e. disaster relief). Table 14 lists the consolidated IA requirements from Appendices D and E.

Table 14. Consolidated information assurance requirements

Information Assurance Requirements
1. Login and User Authentication
2. Access Control
3. User Authentication by Active Directory
4. Unique ID for all users worldwide
5. PKI Enabled (DOD Common Access Card)
6. Provide Encryption
7. Network Security Tools
8. Cross Security Domain Functionality
9. Multi-Level Security Operation
10. Cross Security Domain Functionality

Some disparities exist between organizations regarding the IA requirements and are annotated in Appendices D and E. Three major areas that differ are: login and user authentication (a derived requirement from the requirements: access, user authentication via active directory, and PKI enabled from Appendices D and E), cross security domain functionality, and multi-level security operation. These requirements are tied very tightly to requirements in the functionality and scalability categories and a review of Appendices D and E demonstrates the complexity of this interrelationship and the variation of views. After careful analysis, the differences were synthesized to develop three requirements that satisfy the disparate ones in Appendices D and E. Note the significant difference between the definition of cross security domain and multi-level security, which is a perfect example of how various organizations used terminology differently in Appendices D and E.

a. Login and User Authentication

Provide login and authentication process with variable settings using active directory. Access to network is not consent for access to chat system. Two authentication options: simple authentication (username and password) and strong authentication with username, password, and token (DOD Common Access Card).

b. Cross Security Domain Functionality

The chat tool can be used across equivalent level security domains with coalition partners, eliminating the need for multiple, redundant chat tools. Cross domain access is limited to that required for communication between chat tools (i.e. for SIPRNET we allow access to the chat tool, but prevent any further network access per policy).

c. Multi-Level Security Operation

The chat tool can be used across different level security domains (i.e. NIPRNET chat users to collaborate with SIPRNET chat users in a single tool). This incurs significantly more risk than cross security domain functionality.

3. Scalability

These requirements address a proposed chat tool's ability to rapidly scale in response to stakeholders' changing needs. The stakeholders in Appendices D and E have different need sets based on missions, organization, and doctrine. Table 15 lists the consolidated scalability requirements from Appendices D and E.

Table 15. Consolidated scalability requirements

Scalability Requirements
1. Austere Network Operation
2. Low Overhead Login Process
3. Use Client without Server
4. Distributed Architecture
5. Number of Concurrent Chat Sessions
6. Number of Concurrent Users
7. Specified Quality of Service

The different need sets of stakeholders makes reaching agreement regarding these requirements difficult. The at-sea Navy sails with the C2 capabilities organic to the ships underway, which currently leave little room to scale. The Marine Corps's rapid task

organization inherent to the MAGTF results in very fluid requirements and C2 architectures. The scalability requirements, as defined by these services in Appendices D and E, attempt to address each service's needs. After the reader reviews Appendices D and E, ask "do these requirements address Navy and Marine needs when a Marine unit embarks upon naval shipping?"

We acknowledge the inherent difficulty in decomposing the requirements, so we developed a high-level definition for each. These definitions serve as a common point of departure for future researchers and stakeholders as they decompose these requirements further. They also address implementation many of the non-core functional requirements discussed earlier.

a. Austere Network Operation

The chat tool must be capable of operating on austere networks where low bandwidth and high latency are common. Users must be able to configure functionality as required to maintain the core text-based chat capability from high-level headquarters to the dismounted, tactical user.

b. Low Overhead Login Process

The numerous connects and reconnects of chat users, coupled with authentication, represent overhead paid in bandwidth. An efficient login and authentication process coupled with the alternative of light authentication support tactical users in austere network environments.

c. Use Client without Server

The IM functionality of the chat tool is sufficiently robust to allow its use as the primary means of text communications for units or missions with no chat server planned for or available. Tactical users with extremely low bandwidth may use IM to communicate with higher headquarters, who may then in turn inject the information into the chat system.

d. Distributed Architecture

Larger units would maintain their own chat server or servers that are linked together globally. This distributed architecture supports more users. Survivability increases since units no longer rely on a single central server (server cluster); if the

central link goes down they continue to chat on their local server(s) until the link is restored.

e. Number of Concurrent Chat Sessions

Administrators can set the maximum number of concurrent chat sessions allowed by the chat clients based on network conditions or SA considerations (see Chat Risks Chapter 3). Chat servers support of concurrent chat rooms should only be limited by mission requirements, chat protocols, or network conditions. Current OEF/OIF operational numbers range from II MEF's 10 IRC Servers supporting approximately 84 chat channels to the 350-400 chat channels supported by the Fifth Fleet's four chat servers (Shapiro 2005; Banerjee 2005; Heacox, Moore, Morrison, and Yturralde 2004).

f. Number of Concurrent Users

Chat servers support of concurrent chat users should only be limited by mission requirements, chat protocols, or network conditions. Using the example from concurrent chat sessions: numbers of concurrent users range from over 900 on II MEF's servers to the 2500-3000 on Fifth Fleet's servers (Shapiro 2005; Banerjee 2005; Heacox, Moore, Morrison, and Yturralde 2004).

g. Specified Quality of Service

Chat servers and clients are configurable to ensure continued deliverance of acceptable connectivity and reliability based on factors related to network topology and communication transmission systems. Items that may be configured include functionality, the number of concurrent chat sessions, and the number of concurrent users.

4. Interoperability

The interoperability requirements are reasonably self explanatory and Appendices D and E show that stakeholders citing them are in relative agreement on what they want technically. The stakeholders in Appendices D and E take a technical approach to interoperability. We want to explore the other aspects of interoperability as it relates to chat. Even when everything is technically perfect, there are human and organizational factors that still prevent true interoperability of chat. Table 16 lists the consolidated interoperability requirements from Appendices D and E.

Table 16. Consolidated interoperability requirements

Interoperability Requirements
1. DOD Standards
2. Open Standard
3. Multi-Platform Clients
4. Interoperate with Existing Collaboration Systems
5. Interoperate With Office Automation Tools

Chat interoperability must include doctrine. Chat continues to change the way doctrine is executed across units and services. Not only is chat specific doctrine necessary, but warfighting doctrine must address chat as it does other C2 systems. One example comes from the Expeditionary Warfare Training Group Atlantic (EWTGLANT) AAR dated 15 June 2006. Jamison (2005) noted that Battalion Fire Support Coordination Center Personnel (FSCC), Battalion Watch Officers, and Operations Chiefs used chat to coordinate instead of doctrinal radio nets. The recommendation was to formalize chat into fire support doctrine (Marine Corps Warfighting Publication 3-16: Fire Support Coordination in the Ground Combat Element) as a new C2 method, emphasizing who guards, monitors, and serves as net control (Jamison 2005).

Training is another part of chat interoperability. Many chat users and maintainers are unaware that current chat tools already fulfill some chat requirements called for in Appendices D and E. The ad hoc nature of chat precludes formal training. Chat experimentation during TW 05 proved that training was necessary for Universal Chat client (UCC) users, Multi-Level (ML) Chat users, and Persistent War Room (PWR) users, to become aware these chat tools' features and understand how to use them (TW05 Analysis Report 2006).

E. TRIDENT WARRIOR 05

1. Information Management Chat Experiment Results Analysis

This section reports the TW05 experiment results and conclusion for the high-level objective "Define Navy FORCEnet DOTMLPF requirements for a maritime chat tool." The experiment objectives are listed in Table 17 and the experiment results by objective are listed in Table 18.

Table 17. TRIDENT WARRIOR 05 Information Management chat objectives

Objective 2	**Universal Chat Client (UCC)** - Assess the capability of UCC to fill the documented gaps that currently exist in current maritime chat protocols used throughout the US Navy.
Objective 3	**Über Chat** - Does Űber Chat provide functionality that fills identified gaps in current maritime chat protocols?
Objective 4	**Extensible Messaging and Presence Protocol (XMPP)** – Does XMPP provide functionality that fills identified gaps in current maritime chat tools?
Objective 5	**Multi-Level Chat (ML Chat)** - Does ML Chat's unique functionality of chatting across two or more domains provide the functionality necessary for Navy Maritime Chat?
Objective 6	**Persistent War Room (PWR)** - Will PWR and Chat Logging operate over lower bandwidth subnets and provide the operator ready access to chat functions and supporting information as well as archived chat logs?
Objective 8	**Distributed Chat Architecture (DCA)** – Compare the proposed DCA (hub and leaf) to the current (hub & spoke) IRC communications architecture. Provide a technical solution to operator concerns including loss of situational awareness, reconnection to servers after a communications outage, intra-ship text chat communications when off-ship communications are down.

Table 18. TRIDENT WARRIOR 05 Information Management chat results by objective (After: TW05 Analysis Report 2006)

Objective 2	**Universal Chat Client (UCC)** - Uses a DCA and is suitable for maritime coalition use with a number of "gap filling" features. It does not support file transfer or file sharing. It successfully operated at low bandwidth with a P-3C using HF IP.
Objective 3	**Über Chat** - Relies on a DCA and improves collaboration. It is easy to use and backward compatible with IRC, but it can exploit any network medium to communicate, thus offering communication even without satellite link availability to the IRC server.
Objective 4	**Extensible Messaging and Presence Protocol (XMPP)** – XMPP functionality was successfully demonstrated in TW05. The transmission path used was not efficient, but DISA designed this particular network architecture for shore establishment assessment. This raises the question about successful operation of XMPP with distributed communications architecture, which has advantages for Battle Groups at sea.
Objective 5	**Multi-Level Chat (ML Chat) –** Has a varied feature set, including the ability to cross-domains, offers much potential value for coalition use, but it lacks sophisticated HSI attributes, which need to be improved.
Objective 6	**Persistent War Room (PWR) -** Easily maintained fleet-wide because it runs via browser and Java applets, vice as a locally installed client, and operated at low bandwidths. HSI attributes are sound and the program contains many features desirable to coalition operations.
Objective 8	**Distributed Chat Architecture (DCA)** - The hub and leaf DCA was superior to traditional hub-and-spoke architecture because it improved SA by preserving chat history; servers automatically re-connected (reducing loss of chat history); bandwidth efficiency was increased; reliance on shore-based servers was eliminated; overall reliability was improved.

Table 19 lists the chat tool evaluation results from TW05 by feature.

Table 19. Comparison of chat tool features (From: TW05 Analysis Report 2006)

Feature Description	MLC	PWR	Uber	UCC	XMPP	Notes
Supports Time Stamps	Y	Y	Y	Y	Y	
Automatic refresh of conversation frame (i.e., does not require clicking *refresh* button)	Y	Y	Y	Y	Y	
Ability to "catch up" the user upon reconnect, i.e., "prefill" with archived messages	N	Y	Y	Y	Y	Uber: Cache catches user up automatically
Ability to view multiple chat rooms at once without clicking	Y	Y	Y	Y	Y	
Alerts user when a new message has arrived	Y	Y	Y	Y	Y	
Alerts when user (self) has lost connection	N	Y	Y	Y	Y	
Streamlined login process (login under one minute)	Y	Y	Y	Y	Y	
Logging capability	Y	Y	Y	Y	Y	UCC has an independent appliation called Universal Chat Logger Uber: can save as .log file
Ability to recall last 20 messages, last 2 days, etc.	TBD	Y	Y	Y	Y	
Archieved Log includes date and time stamp	Y	Y	Y	Y	Y	
Ability to send to only one user (whisper / private chat)	disabled	Y	Y	Y	Y	
Supports 'Broadcast topic' feature upon joining chat room. e.g. 'You have joined xyz chatroom. The current topic is 123'	Y	Y	Y	Y	Y	Uber: user can display topic by using 'options' on the chat window
Supports varying, font size, style (bold, italics), font type, and color	TBD	P	P	P	P	Uber: font size only UCC: cannot change color
Supports collaboration between coalition partners (i.e., ability for NATO to talk to US Navy or ability for US to talk to mult. countries)	Y	N	N	N	N	MLC is CDS chat tool. All others are single domain.
Supports separation between different security domains/enclaves (e.g., SIPRNet, CENTRIXS, CSS)	Y	N	N	N	N	
Supports language translation	TBD	TBD	TBD	TBD	TBD	
Send / receive files	N	Y	Y	N	N	Deselected by DSIR
Ability to hide timestamp on display (Timestamp still appears in the log.)	N	N	Y	Y	N	Relates to declutter; is separate from appearance in log.
Automatic reconnect of users to rejoin chat rooms after lost connection	Y	Y	Y	Y	Y	
Stored on the computer? Or does user make up a username upon each login	N	N	Y	N	N	Uber: stored on computer
Supports white boarding, voice, and video	N	Y	N	N	N	
Ability to create and delete chat room	Y	Y	Y	Y	Y	

2. TW05 Conclusions and Recommendations

The complete Navy FORCEnet DOTMLPF requirements for a maritime chat tool defined by the TW05 experiment results are listed Appendix F. The operational impact, measured impact, and recommendations for the Military Utility Assessment Board are consolidated in the following figures. Figure 5 presents these for the maritime chat tools and Figure 6 presents these for the DCA.

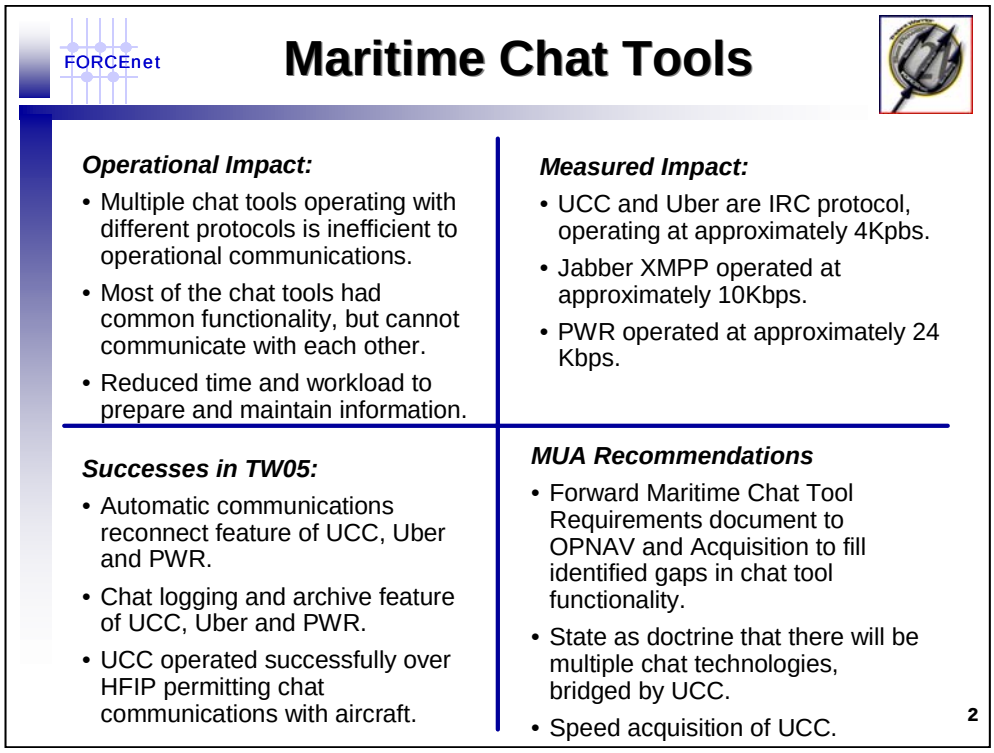

Figure 5. TW05 Chat Tool OAA Quad (From: Steers 2006)

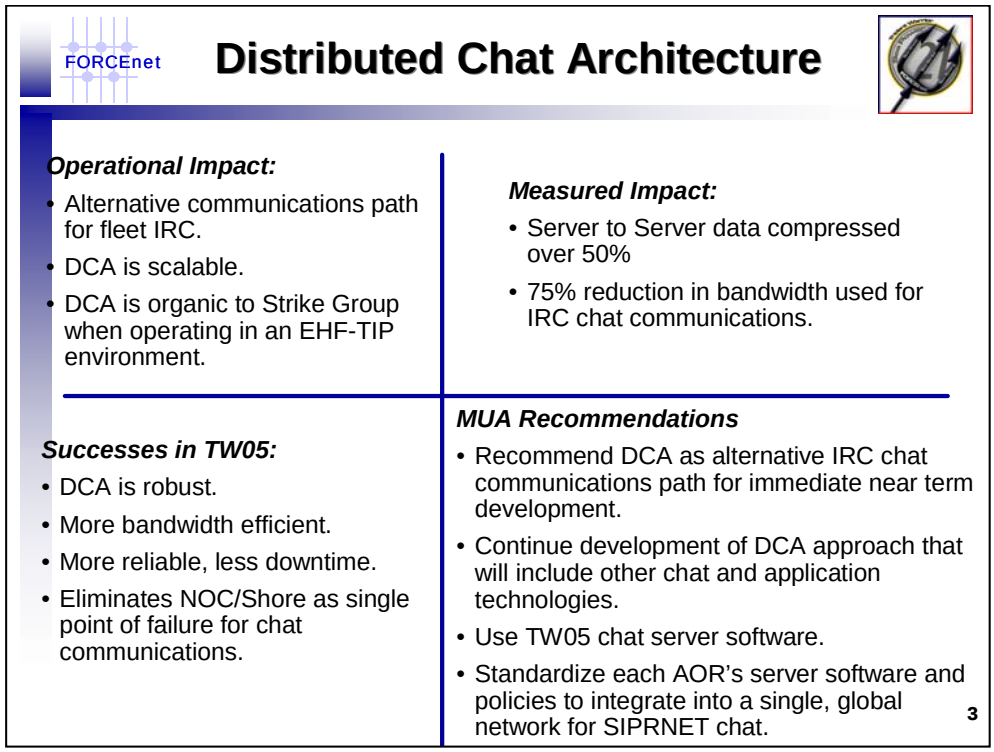

Figure 6. TW05 Distributed Chat Architecture OAA Quad (From: Steers 2006)

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V. CONCLUSION AND FUTURE RESEARCH

A. CONCLUSION

1. How is chat used across the services and warfighting functions?

Warfighters began using chat to solve complex C2 problems across the warfighting functions. Chat has since migrated from a stopgap measure, the proverbial finger in the dike, and become one of the main real-time C2 systems used by Commanders and operators to execute all phases of their doctrinal missions.

This evolution in chat use has not received official acknowledgment. Chat continues to fall under the umbrella of "collaboration" that obscures real usage patterns and prevents the appropriate support and development.

Chat use must be captured by doctrine in two ways. First, chat must be included in the formalized joint and coalition C2 doctrine like other military communications systems used for doctrinal mission planning and execution. Second, warfighting doctrine across the functional areas must incorporate chat with the other C2 systems it uses. We must capture the changes to warfighting doctrine itself that have resulted from chat use. This goes back to the call by Jamison (2005) and others for doctrine to reflect the new realities of chat.

2. Why is chat used across the services and warfighting functions?

We explored the reasons why warfighters use chat. In a single sentence:

> Warfighters use chat because they have found it the best communications method available for real-time, simultaneous communications between hundreds of users in dozens of units across the services of the US, its coalition partners, and other governmental and non-governmental organizations.

3. What risks are associated with chat use?

There are risks associated with chat use. The technical risks are known and are readily mitigated with existing technology and IA practice. The human factors related to chat use that create risk, specifically the internal risks discussed, must be addressed through a combination of training, organizational structure, and process. Perhaps the greatest risk is if this research's call for doctrinal incorporation of chat goes unheeded.

We demonstrated that chat is used for missions like CAS and fire support, missions with very specific communications captured in the doctrine – why leave chat out?

4. What are the high level chat requirements?

The core requirement is real-time, text-based chat. We must acknowledge the importance of text based communications, with chat at the current forefront, and provide the required support, research, and development. This research does not expect chat to look the same in 10 years; however, we must support chat in its current state so that we may intelligently move it forward.

Doctrine for chat and incorporating chat is a critical requirement. Chat requires equivalent codified procedures to tactical voice radio (e.g., over, out, MIJI Reports (Meaconing, Intrusion, Jamming, and Interception)). To leave this to individual units, whatever the level, invites a continuation of the issues observed and addressed in this research.

A development approach using the four requirement categories: functional, IA, scalability, and interoperability, will allow stakeholders to see the interrelationships. This provides a framework for the functional decomposition of the high-level requirements and design of a workable architecture.

B. FOLLOW-ON RESEARCH

1. Chat (Data) Mining

Modern data and text mining tools applied to chat logs present unique knowledge discovery opportunities. The ability to conduct statistical and trend analysis on tactical communications provides doctrinal, technical, and HSI research opportunities.

2. Net-Centric Enterprise Services (NCES)

The NCES collaborative suite capabilities documents, developed by DISA, include a requirement for a chat capability. Research into NCES's ability to meet warfighter chat requirements would be worthwhile. Does NCES meet the requirements of bandwidth disenfranchised units like a Marine rifle company commander, an Army Stryker Brigade Platoon Leader, an underway Navy frigate, or Coast Guard Cutter?

3. Extensible Markup Language

Extensible Markup Language (XML) presents innovative opportunities regarding chat. How can XML be used for data compression, protocol translation, logging, etc?

4. Human Factors

There are numerous HSI factors regarding chat that warrant continued research. How does chat affect the "human in the loop", the organization and the process?

5. Specific Warfighting Doctrine

In-depth research into chat use and a specific area of warfighting presents an exciting research opportunity. Our successful use of UAVs is directly related chat -where is chat use and UAV operations going? Some recommended topics for research are: CAS, fire support (artillery and Naval Surface Fire Support), and Marine Corps Distributed Operations.

6. Information Assurance

A researcher could develop a System Security Authorization Agreement (SSAA) for chat (general or a specific chat tool). The resulting document would provide an in-depth catalog of all risks and proposals to mitigate the risks to an acceptable level.

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APPENDIX A. ACRONYMS

ACE	Airborne Command Element (USAF) Aviation Combat Element - (USMC) Analysis Control Element - (USAF)
AFB	Air Force Base
AFOSI	Air Force Office of Special Investigations
AMF	Afghan Militia Forces
AO	area of operations
AOR	area of responsibility
ASD (NII)	Office of the Assistant Secretary of Defense for Networks and Information Integration
ASOG	Air Support Operations Group
AUSCANNZUKUS	Australia, Canada, New Zealand, United Kingdom, United States
BA JFC	Battlespace Awareness Joint Functional Concept
BMC2	Battlefield Management Command and Control
BOLO	be on the lookout
C2	command and control
C2 JFC	Command and Control Joint Functional Concept
C2 JIC	Command and Control Joint Integrating Concept
C4I	command, control, communications, computers, and intelligence
C5O	Command, Control, Communications, Computers, and Combat Systems Officer – (US Navy)
CAAT	combined anti-armor team
CAOC	combined air operations center
CAS	close air support
CBA	capabilities based assessment
CCJO	Capstone Concept for Joint Operations
CFACC	Combined Force Air Component Commander
CFLCC	Coalition Force Land Component Command
CG	Commanding General
CIO	Chief Information Officer
CJCS	Chairman of the Joint Chiefs of Staff
CJSOTF	Combined Joint Special Operations Task Force
CMC	Commandant of the Marine Corps
CMO	civil military operations
CNA	The Center for Naval Analyses
CNO	Chief of Naval Operations
COCOM	combatant command
COMFLTFORCOMINST	Commander Fleet Forces Command Instruction
COMNAVNETWARCOM	Commander Naval Network Warfare Command
CONOPS	concept of operations

COP	common operational picture
COWAN	coalition wide area network
CS	civil support
CSAR	combat search and rescue
CSG	Carrier Strike Group
CVN	Multi-Purpose Aircraft Carrier (Nuclear Propulsion)
D14	US Coast Guard District 14
DAA	designated approving authority
DASC	direct air support center
DCA	distributed chat architecture
DCTS	Defense Collaborative Tool Suite
DISA	Defense Information Systems Agency
DO	Distributed Operations
DOD	Department of Defense
DOTMLPF	Doctrine, Organization, Training, Material, Leadership and Education, Personnel and Facilities
DS	direct support
EMW	Expeditionary Maneuver Warfare
EP	emergency preparedness
ESG	Expeditionary Strike Group
EWTGLANT	Expeditionary Warfare Training Group Atlantic
FAC	forward air controller
FBI	Federal Bureau of Investigation
FCS	Future Combat Systems
FFG	Guided Missile Frigate
FFH	Halifax (or City) Class Frigate (Canadian)
FM	field manual
FOB	forward operating base
FRAGO	fragmentary order
FSCC	fire support coordination center
GBS	Global Broadcast System
GIG	Global Information Grid
GISAC	Georgia Intelligence Sharing Analysis Center
GWOT	Global War on Terrorism
HLD	homeland defense
HLD CS JOC	Homeland Defense and Civil Support Joint Operating Concept
HMCS	Her Majesty's Canadian Ship
HSI	human systems integration
IA	information assurance
IM	information management
IO	information operations
IRC	Internet Relay Chat
ISR	intelligence, surveillance, and reconnaissance
IWS	InfoWorkSpace

JCIDS	Joint Capabilities Integration & Development System
JCS-J6	Joint Chiefs of Staff J-6
JFC	Joint Functional Concept
JIC	Joint Integrating Concept
JOAF	Joint Operations Area Forecast
JOC	Joint Operational Concept
JOpsC	Joint Operations Concepts
JROC	Joint Resource Oversight Council
JTF	joint task force
JV2020	Joint Vision 2020
KM	knowledge management
LFA	lead federal agency
LFOC	landing force operation center
LHD	Amphibious Assault Ship (Multi-Purpose)
LNO	liaison officer
LOE	limited objective experiment
LSD	Dock Landing Ship
LZ	landing zone
MAGTF	Marine Air Ground Task Force
MCCDC	Marine Corps Combat Development Command
MCOIN	Maritime Command Operational Information Network
MCO JOC	Major Combat Operations Joint Operating Concept
MEDEVAC	medical evacuation
MEF	Marine Expeditionary Force
METOC	meteorological and oceanographic
MEU (SOC)	Marine Expeditionary Unit Special Operations Capable
MIO	maritime interdiction operation
ML Chat	Multi-Level Chat
MOPP	mission oriented protective posture
MS Chat	Microsoft Chat
MSPF	maritime special purpose force
NC JFC	Net-centric Joint Functional Concept
NC JIC	Net-centric Joint Integrating Concept
NCES	Net-Centric Enterprise Services
NCP	Navy Capability Pillar
NETCOM	Network Enterprise Technology Command (US Army)
NETWARCOM	Naval Network Warfare Command
NIPRNET	non-secure internet protocol routed network
NPS	Naval Postgraduate School
NRC	National Response Center
OAG	operational advisory group
ODA	operational detachment-Alpha

OEF	Operation ENDURING FREEDOM
OEO	Other Expeditionary Operations
OGA	other government agency
OIF	Operation IRAQI FREEDOM
OMFTS	Operational Maneuver From The Sea
OODA	observe, orient, decide, act
OPNAV	Office of the Chief of Naval Operations
OWS	Operational Weather Squadron
P2P	peer to peer
PAG	Public Affairs Group
PHIBGRU	Amphibious Group
PHIBRON	Amphibious Squadron
PUC	personnel under control (not a POW)
PWR	Persistent War Room
PACSCI	Pacific Science & Engineering Group
RPG	rocket propelled grenade
SA	situational awareness
SAR	search and rescue
SATCOM	satellite communications
SD JOC	Strategic Deterrence Joint Operating Concept
SIPRNET	secure internet protocol routed network
SITREP	situation report
SPAWAR	Space and Naval Warfare Command
SSAA	System Security Authorization Agreement
SSC-SD	SPAWAR Systems Center San Diego
STESG	Sea Trial Executive Steering Group
STOM	Ship To Objective Maneuver
STE	secure telephone equipment
STU	secure telephone unit
SO JOC	Stability Operations Joint Operating Concept
SOA	Sustained Operations Ashore
TACC	tactical air control center
TACP	tactical air control party
TIC	troops in contact report
TRADOC	Training and Doctrine Command (Army)
TRAP	tactical recovery of aircraft and personnel
TW04	TRIDENT WARRIOR 04
TW05	TRIDENT WARRIOR 05
UAV	unmanned aerial vehicle
UCC	Universal Chat Client
USCENTAF	US Central Air Forces Command
USCENTCOM	US Central Command
USMARFORLANT	US Marine Forces Atlantic
USNAVCENT	US Naval Forces Central Command
USPACOM	US Pacific Command
USSOUTHCOM	US Southern Command

VBSS	visit, board, search, and seizure
VMU	Marine Unmanned Aerial Squadron
WMD-CST	Weapons of Mass Destruction Civil Support Team
XML	Extensible Markup Language
XMPP	Extensible Messaging and Presence Protocol

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APPENDIX B. CHAT SURVEY DEMOGRAPHICS

US Marine Corps

MOS	O5	O4	O3	O2	Total
0180: Adjutant			1	1	**2**
0202: MAGTF Intelligence Officer		1	2		**3**
0206: Signals Intelligence Officer			2		**2**
0302: Infantry Officer		1	1		**2**
0303: Light-Armored Vehicle Officer			1		**1**
0402: Logistics Officer		1			**1**
0602: C2 Systems Officer			3	1	**4**
0802: Filed Artillery Officer		3			**3**
3002: Ground Supply Officer			1		**1**
6002: Aircraft Maintenance Officer			1		**1**
7202: Air C2 Officer		1			**1**
7525: Pilot VMFA		1			**1**
7562: Pilot HMH/M/L/A		2			**2**
7566: Pilot HMH/M/L/A			1		**1**
7577: Weapons and Tactics Officer			1		**1**
7588: NFO (EA-6B EWO)			2		**2**
Total	**0**	**10**	**16**	**2**	**28**

Operational Experience

Operation	Tours
ENDURING FREEDOM	13
ENDURING FREEDOM-PHILIPPINES	1
IRAQI FREEDOM – I	16
IRAQI FREEDOM – II	7
SUBSEQUENT IRAQI FREEDOM ROTATION	2
SOUTHERN WATCH	3
UPHOLD DEMOCRACY	1
ALLIED FORCE	1

Billets

Fire Support Coordinator, 3d Marine Regiment
S-1 (Adjutant), 3d Battalion, 3d Marine Regiment
S-6 (C2 Officer), 3d Battalion, 3d Marine Regiment
S-2 (Intelligence Officer), 2nd Battalion, 5th Marine Regiment
S-6, 2nd Battalion, 5th Marine Regiment
S-2, 6th Marine Regiment
S-3 (Operations Officer), 3d Battalion, 6th Marine Regiment
Rifle Company Executive Officer, 1st Battalion, 8th Marine Regiment
S-3A (Assistant Operations Officer), 11th Marine Regiment
Commanding Officer Battery M, 3d Battalion, 11th Marines
Supply Officer, 1st Combat Engineer Battalion
Company Commander, 1st Light Armored Reconnaissance Battalion
S-3A, 3d Radio Battalion
S-3, Combat Service Support Group 3
S-3A, Transportation Support Battalion, 1st Marine Logistics Group
S-6, Transportation Support Battalion, 2nd Marine Logistics Group
KC-130, Liaison Officer, 22nd Marine Expeditionary Unit (Special Operations Capable)
S-2A (Assistant Intelligence Officer), 24th Marine Expeditionary Unit (Special Operations Capable)

S-6A, 24th Marine Expeditionary Unit (Special Operations Capable)
S-3A, Marine Unmanned Aerial Vehicle Squadron 2
Squadron Pilot, Marine Heavy Helicopter Squadron 465
Squadron Pilot, Marine Medium Helicopter Squadron 364
Assistant Aircraft Maintenance Officer, Marine Air Logistics Squadron 41
Electronic Warfare Department Head, Marine Tactical Electronic Warfare Squadron (VMAQ) 4
Aircraft Maintenance Officer HMM-265 (REIN), 31st Marine Expeditionary Unit (Special Operations Capable)
Staff Secretary, 2nd Marine Aircraft Wing
3rd Radio Battalion Detachment Officer in Charge to 11th Marine Expeditionary Unit (Special Operations Capable)
TOPGUN Instructor

US Air Force

MOS	O5	O4	O3	O2	Total
11A: C-130 Pilot		1			**1**
12B3: Bomber Navigator		1			**1**
14N3: Intelligence Officer		2	3		**5**
15W3: Weather Officer		2	4	1	**7**
71S3: Special Investigations Officer			1		**1**
Total	**0**	**6**	**8**	**1**	**15**

Operational Experience

Operation	Tours
ENDURING FREEDOM	7
IRAQI FREEDOM – I	8
IRAQI FREEDOM – II	2
SOUTHERN WATCH	4
PROVIDE COMFORT	1
SECURE TOMRROW	1

Billets

J3 METOC, US Southern Command
Vance AFB
437th Airlift Wing (Special Operations Division)
55th Wing
Air Force Office of Special Investigations Detachment 105
Headquarters Air Force Space Command
Combined Air Operations Center, Al Udeid Air Base, Qatar
8th Fighter Wing, Kunsan Air Base, Republic of Korea
28th Operational Weather Squadron
Graphics Flight Commander, USCENTAF
11th Bomb Squadron
HQ, 2nd Air Force
421st Fighter Squadron
17th Operational Weather Squadron
C-32 (Boeing 757) Pilot, 1st Airlift Squadron

US Navy

MOS	O5	O4	O3	O2	Total
1110: Surface Warfare Officer			3		**3**
1310 : Helicopter Pilot		1			**1**
1600: Information Professional		1			**1**
1630: Intelligence			1		**1**
6120: SWO LDO	1				**1**
Total	**1**	**2**	**4**	**0**	**7**

Operational Experience

Operation	Tours
ENDURING FREEDOM	1
IRAQI FREEDOM – I	1
JTF-Katrina	2

Billets

Operations Officer (OpsO), Helicopter Anti-Submarine Squadron Three
Fleet Information Systems Officer, Commander Third Fleet
Command, Control, Communications, Computers, and Combat Officer (C5O), USS IWO JIMA (LDH-7)
Fire Control Officer, USS STOUT (DDG-55)
Assistant OpsO, Amphibious Squadron Four
Squadron Intelligence Officer, Strike Fighter Squadron (VFA) 146
Navigator, USS CROMMELIN (FFG-37)

US Army

MOS	O5	O4	O3	O2	Total
18A: Special Forces Officer		1			**1**
74A: Chemical Officer		1			**1**
13A: Field Artillery Officer			1		**1**
Total	**0**	**2**	**1**	**0**	**3**

Operational Experience

Operation	Tours
ENDURING FREEDOM	2
IRAQI FREEDOM	1

Billets

Special Forces ODA Commander, 3d Special Forces Group (Airborne)
2nd Infantry Division, USFK, Korea
S-4 Officer, 41st Field Artillery Brigade

COALITION

Country/Service	O5	O4	O3	O2	Total
Canadian Forces (Navy)			1		**1**
New Zealand (Navy) Principle Warfare Officer		2			**2**
Total	**0**	**2**	**1**	**0**	**3**

Operational Experience

Operation	Tours
ALTAIR (CANADIAN OEF PARALLEL)	1
UNISON (CANADIAN KATRINA)	1

Billets

Combat Officer, HMCS TORONTO (FFH-333)
New Zealand Maritime Operations Staff
Joint CIS Plans - Maritime (J65M), Head Quarters Joint Forces New Zealand

APPENDIX C. CHAT SURVEY EXAMPLE

OPERATIONAL CHAT REQUIREMENTS

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Purpose

This data call seeks to generate operational, user-level data concerning text-based chat usage.

Instructions

This data call has two parts:

1. Respondent information.

2. Twelve questions. A series of questions designed to capture respondent experience. When answering, use specific examples. Examples may be drawn from operational and exercise experiences.

*Respondents may add additional comments, inputs, etc at the end of the document; however, please ensure they are clearly defined.

Respondent Information

1. Rank:

2. Service (& Country):

3. MOS (Warfare Designator):

4. Last billet and unit:

5. Operations participated in:

Questions

Respond with specific examples. Explain:

- **What chat tool(s) were used**
- **What services, coalition partners, or other organizations were involved in the chat**
- **How it affected your ability to perform the task**
- **Why chat was used rather than another form of communication/collaboration.**
- **Specify if you used chat for PLANNING, EXECUTION, or BOTH**
- **Consider both operational and exercise experience**

1. Have you used chat during the Marine Corps Planning Process (MCPP) or Rapid Response Planning Process (R2P2)/Crisis Action Planning (CAP)?

2. Have you used chat for target planning and/or strike execution?

3. Have you used chat for tasking intelligence assets? Have you used chat to collect or disseminate intelligence?

4. Have you used chat for operational execution (tasking, coordinating, passing prowords, etc)? Treat each independently and provide examples.

5. Have you used chat for logistical planning and/or execution?

6. Have you used chat for cross boundary coordination (same service, joint forces, or coalition forces)?

7. Have you used chat for C2/C4ISR Systems Installation, Operation, and Maintenance (IOM) to include troubleshooting?

8. Have you used chat to plan, request, or coordinate Search and Rescue (SAR) or MEDEVAC?

9. Have you used chat to plan, task, coordinate, or execute Combat Assault Support or Close Air Support?

10. Have you used chat for supporting arms coordination, fire plan development, or execution?

11. Have you used chat for planning, coordinating, or executing Civil Military Operations?

12. Have you used chat for any tasks not listed here?

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APPENDIX D. SERVICE CHAT REQUIREMENTS COMPARISON

SERVICE TEXT-BASED CHAT REQUIREMENTS COMPARISON				
Requirement	**USN**	**USMC**	**USA**	**USAF**
FUNCTIONALITY				
Participate in Multiple Concurrent Chat Sessions	X (Tile, minimum 10; participating is monitoring & sending; tactical users treat as radio)	X (Open, join, and chat simultaneously)	X	X
Persistent Rooms & Transitory Rooms	X (Log both types; persistent remains when empty, transitory ends when last user leaves)	X (invite to session on ad hoc basis; administrator should be able to promote ad hoc to persistent)		X (persistent and ad hoc conferences)
Room Access Configurable by Users	X (Public, private, hidden; related to login overhead issues; assign user(s) as moderators)	X (Moderator to control and manage chat sessions)		X (admit, deny, remove users)
Automatic Reconnect & Rejoin Rooms	X			
Thread Population/Repopulation	X (User controlled, select portion of log to repopulate)		X (catch-up feature for late entry)	
Private Chat "Whisper"	X (Logging of these configurable by user)			
One-to-One IM (P2P)				X
User Configured System Alerts	X (Keyword configuration; audio/visual alarm; user connect/disconnect)			
Suppress System Event Messages	X (Connect/disconnect of users not shown in thread; configurable alerts for specific user connect/disconnect)	X (systems events not in text channel but system control channel)		
Naming Conventions Identify Functional Position	X (Functional name stays logged in, user attached changes)	X (view identity of participants)	X	
Multiple Naming Conventions	X (Varies with scope of room)			
Multiple User Types				X (moderator, participant, viewer)

Date/Time Stamp	X (Connect, disconnect, messages)		X	X (For auditing)
Chat Logging	X (Central on server; user searchable)	X (save and archive)	X (save chat and IM content)	X (For auditing)
User Access to Chat Logs	X (User searchable from Chat Logging)	D (Searches and queries of logged data)		X
INFORMATION ASSURANCE				
Access control				X(members-only, password-only, and invite-only)
PKI Enabled (DOD CAC)				X
User authentication via Active Directory and LDAP ver3				X
Unique ID for all users worldwide				X
Provide Encryption				X (DES, 3DES, and AES encryption (up to 256-bit))
Multi-Level Security Operation		D		
SCALABILITY				
Austere Network Operation	X (100 bps per user/room; tactical platforms <10Kbps; satellite latency)	D (EPLRS; I MEF IRC Implementation)	X (<56kbps, <256kbps, <1024kbps)	X(2.4 Kbps)
Low Overhead Login Process	X (lightweight authentication or optional)			
Use Client Without Server	X (P2P between clients – SOC model)			
Distributed Architecture	X (Ships have organic capability)			X (operate globally & federated)
# Concurrent Chat Sessions	X (40 threshold)			
# Concurrent Users	X (2000 threshold)		X (<25, <50, <100)	X (Single session=500+; federated=500,000+)
Specified Quality of Service	X (Response time, reliability, latency – all TBD)			
INTEROPERABILITY				
DOD Standards	X			X (based on standards by any recognized standards body)
Multi-Platform Clients	X (servers: Solaris, Linux, BSD, IBM,			X (1. Applications (Win32, UNIX)

	and Windows server 8; clients: (WinX, Linux, Windows CE, and MacOS) mobile devices/handhelds)			2. Applets (Java, VM) 3. Web Browser-only)
Interoperate with Existing Collaboration Systems		X (188/220 interface [radio communications] D-DACTs)		X (Interoperate with existing USAF IM, Chat, and Presence systems: 1. InfoWorkSpace, 2. DCTS (Envoke), 3. mIRC (IRC), 4. Sametime (SIMPLE))
Interoperate With Office Automation Tools		X		

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APPENDIX E. SELECT COMBATANT COMMAND AND DEFENSE INFORMATION SYSTEMS AGENCY TEXT-BASED CHAT REQUIREMENTS COMPARISON

SELECT COMBATANT COMMAND AND DEFENSE INFORMATION SYSTEMS AGENCY TEXT-BASED CHAT REQUIREMENTS COMPARISON				
Requirement	**JFCOM**	**CENTCOM**	**NORTHCOM**	**DISA**
FUNCTIONALITY				
Participate in Multiple Concurrent Chat Sessions	X (Monitor & participate)	X (Multiple Simultaneous Chat Sessions Viewable)	X (Ability to simultaneously view multiple rooms on monitor)	X (Multiple Room View)
Display Each Chat Session as Separate Window	X			X (Multiple Room View)
Persistent Rooms & Transitory Rooms			X (Chat room remains in existence even is all participants leave)	X (Persistent rooms)
Room Access Configurable by Users	X(users add users & invite users)		X (Quick and easy for new users requiring immediate access; includes new user registration)	
Automatic Reconnect & Rejoin Rooms				X (Reconnect)
Thread Population/Repopulation		X (Ability to re-call text messages for a break in connectivity)		X (Message history on command)
One-to-One IM (P2P)			X (Must provide a controlled text-based chat environment; tool should queue messages for offline users)	X (From bandwidth/COCOM statement)
Off-line Messaging				X
User Configured System Alerts			X (User manually send targeted or broadcast alerts to other users, the tool should automatically	

			notify user based on criteria that the user has determined (e.g. highlighted words))	
Text Copying	X (Copy & paste text from all applications)		X	
Text Entering	X (Ability to enter original text)			
Text Display	X (Sequentially & continuously displayed; intuitively identify text provider; users can scroll through text of entire session)			
Text Retention in Workspace	X (Text remains in workspace until removed by selected user(s))			
Hyperlinks			X (URLS recognized and active within chat text)	
Interrupt Sessions	X (Session managers and admins can interrupt active channels as needed			
Foreign Language Text Translation	X (Text & data)			X
File Transfer		X (File Transfer Capabilities)	X	
Portal Capable		X (Capable of running in a portal environment)		
Web Client		X (Web capable client)		X (Web/Flash client)
Presence Awareness			X (User ability to see who is online)	X
Naming Conventions Identify Functional Position	X		X	

Multiple Naming Conventions	X (Identify user by date/time stamp, name, functional name)		X (Role based users have the ability to "turn off" role and become themselves or another role based name)	
Distribution Group Mgmt System for Users	X (On/off feature to select user participants)			
Date/Time Stamp	X	X(Date/Time Stamp on all Messages)		X
Chat Logging	X (RECORD; retrieve & playback)		X (Server should log all chat activity for future retrieval)	X (Server side logging)
User Access to Chat Logs	X		X (Searchable; User optional logging of chat activity in monitored channels)	
INFORMATION ASSURANCE				
Access control		X (Use Active Directory for authentication)	X (Secure single sign-on and seamless user authentication	X (XMPP)
Provide Encryption			X (integration with industry standard SSL encryption)	X (XMPP)
Network Security Tools		X (Meet current security requirements)	X (compatibility with firewalls and proxy servers)	
Cross Security Domain Functionality		X (Capable of sending messages between different networks of various security)	X	
SCALABILITY				
Austere Network Operation		X (Useable by low bandwidth users)		X (Low-bandwidth Chat/IM capability identified by COCOMs as lowest common denominator, "gotta have" collaboration service
INTEROPERABILITY				

DOD Standards			X (Interoperable with approved DOD network configurations and applications – Plug-n-Play)	
Open Standard				X (Open protocol; industry support; future development)
Multi-Platform Clients			X (User accessible on any device; requires no client-software download; works with multiple client platforms; allows easy communication across the same system	
Interoperate with Existing Collaboration Systems		X (Interoperable with Current Chat Infrastructure - Native or Bridge Capable)	X (Must allow communication with mission partners (i.e. DHS))	X

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APPENDIX F. TRIDENT WARRIOR 05 MARITIME CHAT REQUIREMENTS

TRIDENT WARRIOR 05 Maritime Chat Requirements (From: Steers 2006a)

Text Chat Requirements By Category	Shall	Should	Notes
I. DOD/Industry Standardization			
Open Standard		X	
Open Architecture	X		
Service Oriented Architecture	X		
II. Security			
Comply with current DOD security requirements	X		
Comply with DOD IT Standards Registry (DISR)	X		
III. Communications Scalability			
Operate in Ethernet, UHF and HF communications mediums	X		
Low Bandwidth	X		
Low Data Rate	X		
High Latency	X		
Operate globally in a federated network	X		
Operate on local, disconnected, and closed network	X		Tactical environment
Support Cross Domain or Multi-National solution	X		Must support CDS or Multi-National Information Sharing solution
Support Distributed Server Architecture	X		
Support UNIX and Windows interoperability	X		
Link chat tool functionality to bandwidth availability		X	Maintain core text chat capability at very low bandwidth levels (less than 2.4 Kbps)
Accommodate not less than 1000+ participants per chat session		X	

Instant Messaging (IM) capable		X	Should accommodate functionality, but not at the expense of maintaining a text communication capability at low bandwidth requirement.
Voice over IP (VoIP) chat capable		X	Should accommodate functionality, but not at the expense of maintaining a text communication capability at low bandwidth requirement.
IV. Communications Disruptions			
Intermittent Connectivity - support multiple server disconnects	X		
Limited number of reconnect attempts	X		Default value can be modified by operator up to a predetermined maximum
Selectable interval (time) for reconnection attempt	X		Provides tactical functionality
Chat tool is operable after communications disruption and sends text upon reconnection	X		
V. Functionality			
Time stamp messages	X		
Date stamp messages	X		
Time stamp members joining and leaving rooms	X		
Date stamp members joining and leaving rooms	X		
Automatic download of logs on joining (pre-fill chat rooms with past messages)	X		Quantity of pre-fill is selectable by operator
Maintain chat history during network outages	X		
Maintain screen contents upon reconnect	X		
Support visual alerts	X		
Support audio alerts	X		
Visual and/or Audio notification of communication interruption to operator	X		
Chat Client remains operable during communications interruption	X		
Automatic rejoining of chat rooms upon communications restoration	X		

Alert operator for new messages	X		
Provide audio/visual alerts to operator for selected key words		X	
Ability to "cut and paste" text between multiple chat rooms	X		
Support varying font size, font type, style (bold, italics) and color		X	Font Size (from 9 to 20), type (Ariel, Times New Roman or Courier New).
Viewing of member entry / exit		X	Operator selectable (on / off) configuration to reduce screen clutter
Messages can be transmitted by hitting "Enter" key in addition to clicking "Send" button with mouse	X		
VI. Chat Sessions / Rooms			
Public chat rooms	X		Users must be able to freely enter vice "invite only"
Private chat rooms		X	
Permanent rooms (functional)	X		Rooms need to remain when users disconnect
Temporary rooms		X	Rooms dissolve after last member leaves
Limit access to private chat rooms		X	
Allow user to join or leave chat room at will	X		
Monitor multiple chat rooms	X		Not less than 10
Participate in multiple chat rooms simultaneously	X		
Visual "tiling" of multiple chat rooms	X		Operator selectable configuration, not less than 10 rooms
Resize chat room windows	X		
Support multiple layouts of chat rooms (tabbed, tiled, etc)		X	
Ability to search for chat rooms within a certain category		X	
VII. Logging / Archiving			
Automatic logging	X		Logging is not optional at server or workstation
Log all (server & room) messages at server	X		
Log public chat room conversations	X		
Log private chat room conversations	X		

Log permanent chat room conversation	X		
Log temporary chat room conversation	X		
Automatic sending of stored chat upon communications restoration	X		
Logs are retrievable		X	
Logs are searchable		X	
VIII. User Login and Identification			
Streamline login process	X		Lowest possible connection overhead
Configure to startup chat client automatically upon login/reboot		X	Selectable by operator
Configure to automatically join a user specified set of chat rooms upon login		X	
Support the use of functional title (IKETAO) and user name (LCDR John Smith)	X		For Permanent rooms provide the ability for watchstanders to change name with function without having to log out and in. This maintains continuity of chat session

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